



# THE ART AND SCIENCE OF NUTRITION

A Textbook on the Theory and Application  
of Nutrition

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To

JOHN R. MURLIN, Ph.D.

whose research and teaching has  
added much to the advancement of  
nutrition as an Art and a Science







## PREFACE TO THIRD EDITION

This book is designed to cover briefly the fundamentals of nutrition. It, therefore, includes several chapters which perhaps are not regularly included in books on dietetics but which must be included under the broader term nutrition. Such chapters include digestion, the blood, the endocrines, and some appendix material. For those whose time or interest is limited, they may be omitted. For those who have more time or added interest, they are again included in the third edition. It is difficult to adapt data to all time factors and scholastic levels. It seems more reasonable to be overinclusive and permit selection than underinclusive and require supplementation, from the viewpoint of both the instructor and the student.

Increasing interest and importance is being attached to food in its relation to health, and educational methods whereby this information is disseminated. That our educational program is effective is indicated by data presented by Dr. Sherman in *Nutrition Reviews*. Between 1915 and 1945 our national yearly per capita consumption of milk increased 52 per cent, of green and yellow vegetables, 79 per cent, and of citrus fruits and tomatoes 133 per cent. As he puts it, we are "making people want the benefits which come from better food habits." We are moving toward the threefold goal set by the National Nutrition Conference of 1941—eradication of nutritional deficiency, reduction of infectious diseases, and "such levels of *health plus* that is for all as to ensure to each the degree of *health plus* that is potential in his hereditary birthright." Public opinion is making encouraging demands on producers and purveyors of food and educational and governmental agencies toward these ends. In preparing this third edition, the authors have incorporated the suggestions of reviewers in so far as they were practical and nonconflicting with comments of others. The authors are grateful for constructive criticism and suggestions. Only through them can the book become more widely adaptable. And they are gratified by the kindly and encouraging support which the two previous editions have received.

ESTELLE L. HAWLEY  
GRACE CARDEY

## PREFACE TO SECOND EDITION

Nutrition as a science is playing an increasingly important part in the world of today and will continue to do so in the world of tomorrow. Its value has been established as a weapon of war and as an instrument of peace. Its importance is not only a personal matter—it is national and international.

A friend expressed this widened scope when he wrote: "Food is exciting to me. I like to eat. I like to cook. And when to that is added the gargantuan opportunity to build a nation—a nation with greater health, greater desire for living, greater satisfaction from living, longer life, greater accomplishments from living—an opportunity to make a contribution to the whole scheme of things which nutrition can make—then it is exciting—and no end. The needs of the individual, however, must be studied in order to set the pattern for the nutrition of nations."

The material for this new edition has been brought up to date with the advances in nutrition research of the past two years. The newer knowledge of vitamins, the dietary standards recommended by the Committee on Foods and Nutrition of the National Research Council, and additional adjustments of the normal diet for abnormal conditions are included. Recent pertinent references have been added to the bibliography.

The outline for teaching diet therapy has been entirely revised and in order that the student may more readily follow the changes necessary, the tables dealing with diet adjustment relate directly back to the table showing the normal diet for the normal adult. Lists of supplies for the class work have been added to the laboratory outlines.

In the hope that it may help to stimulate the reader to the most serious consideration of good nutrition as a basis for good health, the authors present this second edition of *The Art and Science of Nutrition*.

ESTELLE F. HAWLEY  
GRACE CARDEN

## PREFACE TO FIRST EDITION

Recognition of the role which nutrition plays in clinical medicine is in no small measure due to Dr. James S. McEster's keen appreciation of the value of nutrition both in the prevention and in the

## PREFACE

cumulative treatment of disease. He visualizes a sturdier, happier, more vigorous race, whose economic and cultural attainment will be greater and whose life span will be longer as the result of intelligent application of the newer knowledge of nutrition with which science has endowed us.

No longer is nutrition a mere matter of meal planning, based upon the meager knowledge or ability of the housewife. It is now a matter worthy of careful consideration and study by the medical profession and its ally, the nurse, in whose hands it often lies and upon whose intelligent cooperation so much depends. The nurse today must be trained to assume the detailed planning of diets and to know why and what adaptations are necessary in various disease conditions. The busy doctor seldom has time to do more than indicate the dietary treatment, he may even omit a request for diet adjustment. The nurse must, therefore, be able to prepare attractive, palatable, and nutritious meals which will tempt the appetite of her patient and at the same time take cognizance of the patient's metabolic dysfunction or need. Recovery from any condition of disease hinges in a large measure upon the nutritional status of the patient. One cannot hope to rebuild or sustain normal body tissue without adequate building material.

It is with realization of the paramount need for scientific knowledge of food and its uses, and of disease and its metabolic consequences, that we have here outlined the principles of normal nutrition and have indicated when, why, and how modification of the normal diet may be necessary. Space limitation prevents detailed discussion but it is hoped that with the fundamentals of nutrition and diet adjustment as given here, and the reference material suggested, the nurse may acquire sufficient knowledge of nutrition as an art and as a science, to enable her to play her role in the betterment of human life.

ESTELLE E. HAWLEY  
GRACE CARDEN

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The authors are further indebted to Charles C. Thomas, publisher, for permission to reproduce material from *The Fundamentals of Nutrition*, and to others, too numerous to mention, who have so graciously granted their material.

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## THE ART AND SCIENCE OF NUTRITION





# PART I

## THE NUTRIENTS

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### CHAPTER I

#### NUTRITION AND ITS PLACE IN THE EVERYDAY WORLD

From the beginning of time, man has been interested in food and its relationship to himself. The professional person—chemist, physiologist, physician, nurse, nutritionist, or health educator—is concerned with the role food plays in the science of nutrition. Most people, however, have a different concept of food. If one were to ask a group of individuals "why do you eat?" a variety of reasons would be forthcoming. These may be expressed as "food tastes good," "habit, eat at certain times," "for sociability," "to keep alive" or "to grow." It is significant that many reasons are often given prior to the one that is the major concern of all who are interested in the physical welfare of others—"for health."

Recently, attention has been directed to the meanings that food might have for the individual. Apart from the metabolic needs for food (with which this book is primarily concerned), the nonmetabolic uses of food have been explored. Bayles and Elbaugh have expressed these as "needs of a person as well as needs of a body." These nonmetabolic uses of food often reflect such needs as social, socioeconomic, or emotional satisfaction. Uppright, in a paper titled "Factors Influencing Food Acceptance," stated: "It has been said that food with man is not just food, it is the crossroads of emotion, religion, tradition, and habit."

Babeock pointed out that an infant found his first satisfaction in eating, his first displeasure in being hungry, and his first human relationship is with the person who feeds him. Food has been interrelated with the emotional and intellectual development of the individual throughout life. Some emotional uses of food which have been suggested are to relieve anxiety, to com-

compensate for rejection, to reward one's self and others, or to be used negatively and deny one's needs. The use of familiar food to relieve tension from sources other than metabolic is an observable but unexplainable fact. Bruch has described the obese child who has found release in food from the tension of being unloved. To a dissatisfied homemaker, eating may mean diversion and thereby a respite from monotony. An adolescent may turn to food to compensate for social rejection. Some foods, such as steak or special desserts, often serve as a reward for work well done by one's self or others. Many feel that it is "spartan" or that it develops character to deny one's needs, and food is often used in this way.

Food frequently expresses interpersonal reactions. It is easy to communicate pleasure or anger by the type of food that is served. Many hostesses feel rejected if food is not eaten and praised. Moore suggests that indifference or resentment is often expressed by not eating what is served or by overlooking the special efforts made. Food many times symbolizes deep meanings of friendliness and affection and the invitation to eat may mean social acceptance. Neighborly gifts often take the form of food.

To many people, food is an expression of socioeconomic status. Ethnic and religious customs are frequently reflected in food. Fish on Friday, turkey for Thanksgiving, and a birthday cake are outstanding examples. An abundance of food is often a mark of success to a man who has known poverty and deprivation. Moore pointed out that foods themselves become "hoity toity" when they meet one or more of these criteria: rare, expensive, difficult to prepare or infrequently liked, extreme in flavor or taste. The homemaker's skill and knowledge are earmarks of her prestige and her claims to respect and deference. Thus, food itself may connote prestige and thereby reflect the socioeconomic status of an individual.

Galdston presented the challenging concept that although people are interested in diets they are not interested in nutrition or even in diets per se. "They are interested in becoming slim, in looking younger or younger than they are, and in being attractive." He suggested further that the individual wants many things but not health alone. His interest lies in good health in order to *do* or to *be* something.

Food, then, has many meanings to many people. To most the nonmetabolic needs of food are strongest. However the individual concerned with the welfare of others realizes that food can be a major contribution to health. Members of this latter group, through the training for their several specializations, are aware of this important relationship. However, in order to be effective nurses, physicians or nutritionists an understanding of the nonmetabolic needs for food must be recognized.

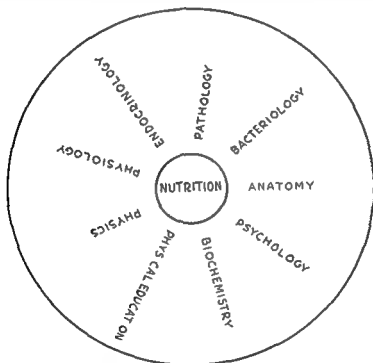


Fig 1—Nutrition is at the crossroads of all other medical sciences

Nutrition has been defined as "the combination of processes by which the living organism receives and utilizes the materials necessary for the maintenance of its functions and for the growth and renewal of its components." Thus it is not an isolated science but is closely interrelated with others. In fact nutrition has been said to be at the crossroads of all other medical sciences (see Fig 1). Not only is this true today, but it is possible to trace this interrelationship through the ages from the origin of our present day physiology, biochemistry, and nutrition.

A review of the development of the science of nutrition reveals an interesting history. Hippocrates (the father of medicine, 460-375 B.C.) wrote: "Let us inquire therefore, what is admitted to be medicine. To me it appears that nobody would have sought medicine at all provided the same kinds of food suited men in sickness and in health." Another aphorism, "Growing bodies have the most innate heat, they therefore require the most food for otherwise their bodies are wasted. In old people the heat is feeble and they require little fuel as it were." He also expressed the thought that persons who are naturally very fat are likely to die earlier than those who are slender. His treatment of patients consisted in dieting, exposure to sunshine, exercise, and psychic diversion.

As Hippocrates was the father of medicine, so Lavoisier (1743-1794) was the first to clearly understand and express our basic knowledge of energy metabolism.

Harvey, Mayow, Priestley, Magendie, and many others illustrate the relationship of nutrition to other disciplines. During the nineteenth century major strides were made in the understanding of the function of the living organism. In addition, investigators sought to isolate and identify the materials necessary for life. Studies attempted to establish the sources of these necessary materials and suggestions were made, as in the words of Prout that "the body is constructed from the foodstuffs ingested and that a diet to be complete must contain all three staminal principles (saccharina, oleosa, and albuminosa)."

Nutrition has been called a "twentieth century science" because of the rapid progress in the identification of nutrients found in foods and the functions of these nutrients in the living organism. Descriptions of these discoveries and related research make fascinating reading. It is important to realize that past research has had a profound effect on present day methods and beliefs.

The first textbook of nutrition in this country was written by Graham Lusk, *Science of Nutrition*, and published in 1906. In 1921, Mary Swartz Rose (1874-1941) through her appointment as Professor of Nutrition at Teachers College, Columbia, became the first nutrition professor at any American university.

Because of the vast range of material it is beyond the scope of this book to trace the historical development of the science of

nutrition. The interested student is referred to the references (Part V) as a source of some of this information. However, whenever possible, reference will be made to past research in the discussion of present trends.

The results of recent surveys published by the Bureau of Human Nutrition and Home Economics indicate that for the most part American nutrition has notably improved during the last 40 years. There seems to be a shift in the types of foods consumed which results in a decrease in cereal products and an increase in vegetables, fruit and milk. Although there are seldom cases of frank vitamin and mineral deficiency, Dr. Russell Wilder suggests there are indications that an indeterminate number of our adult population still suffers from so-called 'subclinical' or borderline deficiencies.

Dr. Pearl Swanson, in a paper presented at the National Food and Nutrition Institute in 1952, reviewed several studies of the food intake of specific groups. In summary she stated: "It may be said that although dietary studies in general indicate that the national diet is good, there still remain in the picture certain vulnerable groups of individuals that should serve as targets of nutrition education. There are children ages 6 to 15 years and in particular adolescent girls, mothers of families aged people, adult women in the age bracket 30 to 70 years and pregnant women."

The F.A.O. (Food and Agricultural Organization of the United Nations) published a second *World Food Survey* in November 1952. In general it was stated that the diets consumed by sample groups in most of the heavily populated regions of the world are quantitatively deficient. Simply, this means that many millions of people do not get enough food to satisfy their hunger. In addition, the *Survey* pointed out that the nutritional quality of the diets was even more unfavorable because "even in countries in which the calorie levels are adequate, diets often do not contain enough protective foods."

Thus, although those concerned with nutrition education can be encouraged by the gradual improvement in the average result of food surveys, there are indications that there are many individuals and groups both here in America and in the world who need further assistance to health through proper food.

Recently, the difference between buoyant or optimum or possible health has been appreciated. The goal of each individual is happiness, optimum health, and efficiency. Fig 2 illustrates that proper food is the hub of the larger wheel of health. Good health is important for what it leads to as well as for health itself.



Fig 2—Adequate food is the hub of the larger wheel of health

Today, on the basis of past research, positive health programs are under way in most communities. One of the outstanding examples is the work of the F A O and W H O (World Health Organization) of the United Nations. Nutrition plays a major role in these programs. The enrichment program in America, fluoridation of public water in some cities, diabetes detection week, well baby clinics, the school lunch program, and many others illustrate constructive health programs in the United States which recognize the importance of nutrition.

Dr Charles Glen King\* has pointed out that, practically speaking, nutrition can be called the science of food and its

\*King, Charles Glen. Basic Research and Its Application in the Field of Clinical Nutrition. J Clin Nutr. 1:1 Sept Oct 1952

relation to life and health. He also set forth four goals toward which the nutrition scientists strive in their understanding of nutrition.

First they (the nutrition scientists) want to be able to identify and measure the concentration of all the useful ingredients in human and animal foods.

Second they want to know how each nutrient functions in living organisms and how these functions interlink with one another.

Third they want to know the quantitative relationships between nutrient intake and health on a life span basis.

Fourth they sense an obligation to assist in the educational activities that will make their work effective in the community at large.

The first three of these goals are concerned with the information set forth in the present volume. The fourth objective, the importance of educational activities is carried out by professional action. There are many opportunities such as patient contact in the clinic, word or home work with mothers groups or in community participation to modify food patterns in accord with present day nutrition concepts and thereby improve health.

Thus by incorporating the newer knowledge of nutrition this book may serve as a reference for those who are professionally concerned with nutrition. In addition it may serve as an introduction to the science of nutrition to students who are entering their chosen field. Practical application of nutrition to specific problems has been included in order to provide meaningful as well as factual information. The addition of charts and suggested learning experiences may both aid the graduate and enhance the understanding of students. It is toward the overall goal of improving the health of our population that this book is directed.

Since communities and nations are but large groups of individuals feeding the masses becomes a matter of grave importance. Economic prosperity can be reflected in the condition of the dinner table. No individual can work efficiently on an inadequate diet. The men of tomorrow will be no stronger than the children of today, whose growth is dependent upon their



but how much was needed, and how these various factors functioned within the body. Recently, labeled molecules and atoms have been used by scientists. A given molecule can be labeled with a radioactive atom. This molecule, then, can be followed throughout its pathways in the body as long as the radioactivity lasts. These isotopes are chemically identical with other atoms of their kind and they can be measured in extremely small quantities. Studies of these tracers have contributed extensively to our present concepts of nutrition.

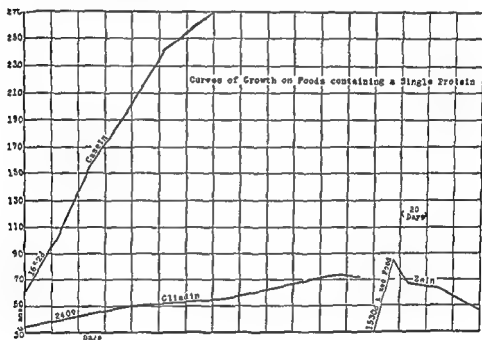


Fig 3 —Showing typical curves of growth of rats on diets containing a single protein. On the casein food (devoid of glycine) satisfactory growth is obtained on the gliadin food (deficient in lysine) little more than maintenance of body weight is possible on the zein food (devoid of glycine, lysine and tryptophan) even maintenance of body weight is impossible (From Mendel L B J A M A 64 1539 1915)

Our current beliefs about the basic needs of the body are based on past research. However, *nutrition is not a static science*. New discoveries new methods of research are constantly coming forth and, consequently, our beliefs are changing. So, because nutrition is a fast moving science, we today believe that tomorrow will bring many great discoveries.

These "materials" which are necessary to the functioning of the living organism are often referred to as nutrients. By defi

nition a nutrient is a substance which takes part in nourishing the body\*. A nutrient can function in the body in three ways

- 1 It can provide fuels which when oxidized in the body release energy
- 2 It can furnish the substances for the building and upkeep of the skeletal structure and the soft tissues of the body
- 3 It can supply the materials which are necessary either to regulate the body processes or from which the body can synthesize its own regulatory substances

A single nutrient may function in the body in more than one way. Similarly a single food the source of nutrients may provide nutrients which will serve one, two, or even all three of the above functions depending on its composition.

There are five major classifications of nutrients: carbohydrates, fats (lipids), proteins, vitamins, and minerals. This is the order in which they will be presented in the present volume. For the most part, carbohydrates and fats provide fuel for energy, although proteins can perform this function. This energy value is expressed in terms of calories. Proteins and minerals supply the materials for the building and upkeep of the body tissues. Again, small amounts of fats (lipids) contribute to body cells. The body regulators, as they are sometimes called, are primarily minerals, vitamins, and proteins. However, other nutrients may supply regulating power. (See Table 1.)

Obviously, it is difficult to rigidly classify nutrients. The grouping suggested in the preceding paragraph represents the primary function of each nutrient. However, through the information gained from radioactive isotopes, important interrelationships among the nutrients have been demonstrated. For example, it is known that thiamine (one of the members of the vitamin B complex) must be present for the oxidation of glucose. These interrelationships will be emphasized as each one is discussed. It is sufficient for the present to be concerned with the major functions of each nutrient.

The chemical analysis of the body is worth quoting; its relative worthlessness in dollars and cents is apparent. At the current price of chemicals, the body's store is worth something less than two dollars. (See Table 2.) Macleod has said that an adult

\*Stern and Henry C. Essentials of Nutrition, p. 13.

TABLE 1  
 ESSENTIAL NUTRIENTS, PRINCIPAL FUNCTIONS, AND PRIMARY SOURCES

NUTRIENTS	PRINCIPAL FUNCTIONS			PRIMARY SOURCES
	PROVIDE ENERGY	BUILDING AND UPKEEP	REGULATE BODY PROCESSES	
Carbohydrates	x			Sugars, starches, cereals, breads, potatoes, root vegetables
Fats	v			Butter, lard, oils, meat fats, nuts, cream
Proteins	x	x	x	Meats, eggs, milk, legumes, cheese
Minerals*				
Calcium		v	x	Milk, cheese, kale, egg yolk
Phosphorus		v	x	Milk, meats, fish, legumes
Sodium			x	Table salt, salted fish and meats, milk, vegetables
Potassium			v	Dried fruits, legumes, cereals, vegetables, lean meat
Chlorine			v	Table salt, salted fish and meats, canned foods
Iodine			v	Sea foods, coastal plants, iodized salt
Iron		v	v	Liver, lean meats, egg yolk, green leafy vegetables, legumes
Copper		v	x	Legumes, liver, lean meats, whole grain cereal and bread
Magnesium		x	v	Legumes, lean meats, cereals, nuts
Manganese			x	Cereals, legumes, liver, green leafy vegetables
Cobalt			v	Green leafy vegetables, whole grain cereals, fruits
Sulfur		v	v	Meats, nuts, legumes fish, hard cheese, egg yolk
Vitamins†				
Fat soluble				
Vitamin A			v	Liver, yellow and green leafy vegetables, fortified margarine
Vitamin D			v	Fish liver oil, fortified margarine, fortified milk
Vitamin E			v	Wheat germ oil, seed oils, navy beans
Vitamin K			v	Green leafy vegetables, pork liver, seeds fruits

\*Other minerals which are believed essential are boron arsenic chromium lithium molybdenum rubidium aluminum fluorine, lead barium silicon nickel tin bromine and zinc.

†Other factors which are believed essential are biotin inositol para aminobenzoic acid rutin adenylic acid and vitamin P. There may be vitamins yet to be discovered.

TABLE 1—CONT'D

NUTRIENTS	PRINCIPAL FUNCTIONS			PRIMARY SOURCES
	PROVIDE ENERGY	BUILDING AND UPKEEP	REGULATE BODY PROCESSES	
Water soluble Ascorbic acid			x	Citrus fruits, fresh fruits, tomatoes
Thiamine			x	Pork, legumes whole grain and enriched breads and cereals
Riboflavin			x	Milk, liver, green leafy vegetables
Niacin			x	Liver, lean meats, legumes, whole grain and enriched breads and cereals
Pyridoxine			x	Rice bran, egg yolk, liver, legumes
Pantothenic acid			x	Liver, lean beef, eggs, whole grain breads and cereals
Choline			x	Egg yolk, soybean, organ meats whole grain breads and cereals
Folic acid			x	Green leafy vegetables, liver, lean meats
Vitamin B <sub>12</sub>			x	Liver, milk, cheese meats

man contains "enough water to fill a 10 gallon jug, enough fat for 7 bars of soap, carbon for 9,000 lead pencils, phosphorus for 2 200 match heads, magnesium for 1 dose 'salts,' enough iron to make a medium size nail, enough lime to white wash a chicken coop, and enough sulphur to rid one dog of fleas "•

Food is the only source of nutrients available to the body. As the result of chemical analysis similar foods may be grouped, according to chemical composition, into classes. Such grouping is known as the classification of food. Details will be found in specific chapters.

Rarely are foods composed of a single constituent. Sugar, which is pure carbohydrate, dry gelatin, which is pure protein, and olive oil, cottonseed oil, and some other oils, which are pure fat, are exceptions. In general, all the several constituents are present in food, but in varying amounts. A food may be said to belong to a certain group only if that nutrient is present to such an extent that, when the food is eaten in

\*Macy, Iole C. Hidden Hunger p. 108—A 154 pound man contains the following:  $\frac{1}{2}$  lb calcium  $1\frac{1}{2}$  lb phosphorus a little more than  $\frac{1}{2}$  lb potassium 1 lb table salt 5 oz sulfur 1 oz magnesium, less than 1 oz iron and the trace elements.



cules to simple, soluble form so that they may be absorbed. The process of digestion takes place along the gastrointestinal tract. In the mouth, which is the beginning of the gastrointestinal tract, the carbohydrates are the only group to be affected. In the stomach, the next organ in digestion, the proteins are partially broken down, and possibly some of the fats. It is in the small intestine, with digestive agents from the pancreas and the liver as well as the small intestine, that the carbohydrates, fats, and proteins are reduced to their simplest form. The end products of carbohydrates (the starches and sugars) are three "simple" sugars: glucose, galactose, and fructose, of fats, fatty acids and glycerol, and proteins, their component amino acids.

There are portions of foods which are not available to the body for nourishment. These are primarily tough fibers known as cellulose. These, along with other solid waste materials, pass into the last section of the gastrointestinal tract, the colon. The process of excretion is that of eliminating this residue from the body.

The end products of digestion—the simple sugars, fatty acids, glycerol, and amino acids, are ready for absorption. This is a complicated function and some of our most recent data concern the interaction of other elements in this intricate process. At this time, it is sufficient to remark that the nutrients pass through the walls of the small intestine into the circulatory system.

The distribution of the nutrients in the body is one of the functions of the human circulatory system. The absorbed nutrients are carried first to the liver and then quickly about the body. A complete circuit of the body takes only about forty seconds.

Some nutrients can, if necessary, serve the body in several ways. When there is no immediate need for the specific end products of digestion, the nutrient passes into what some scientists call the "metabolic pool." From this metabolic pool, the nutrient may ultimately serve one of many functions. Many of the needed "adjustments" to prepare the nutrient for other functions are believed to be made by the liver with the help of certain vitamins and minerals. The usual pathways in the utilization of nutrients along with other possible secondary services are diagrammatically presented in Fig. 4.

This cursory treatment of metabolism will be expanded in later sections of this book. However, it was felt that an outline of the over all functions of the nutrients might prove helpful as a study guide.

One of the most important contributions to our understanding of metabolism in recent years has been the concept of "a dynamic state of affairs in all body tissues." Previously, it was believed that a static condition existed within the body. In other words, a given molecule of adipose tissue was thought to remain inert, after its deposition, for many years. The body was believed to use the fuel foods as they were ingested, and only if an emergency arose was the inert molecule of adipose tissue utilized.

Possible Pathways of Carbohydrates, Fats, and Proteins

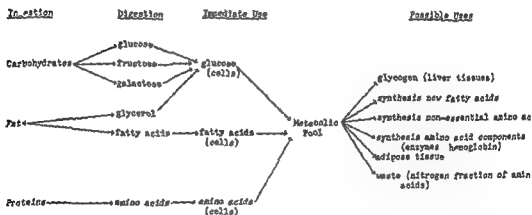


Fig 4

However, the use of radioactive isotopes suggests that this is not the case. The concept now accepted is that there is constant use and replacement in all body tissues of nutrients. This "dynamic state of affairs" is held to be true in such "permanent" structures as bones, tendons, and adipose tissue.

Of the three fundamental questions set forth in this chapter, how we know the basic needs of the body, how factors function within the body, and how much of these factors we need for optimum health, only the last remains.

Until 1935, various standards of recommended amounts of nutrients were suggested by current investigators. These changed from time to time, of course, as no standard is considered

final In 1935 the *League of Nations* formulated standards (minimum requirements) which were based on the information then at hand These standards were the first which were the result of a concerted group effort

Late in 1940, the Food and Nutrition Board of the National Research Council was organized, with the purpose of advising on problems in nutrition in connection with national defense The need for standards on which some degree of general acceptance could be expected was immediately recognized In May, 1941 the *first dietary allowances* were adopted by the Board This action followed critical consideration of tentative allowances and thereby represents the combined judgment of more than fifty persons qualified to express an opinion

The second edition of the *Recommended Dietary Allowances* was published in August, 1945 The third edition was released in October, 1948, and the fourth in November, 1953 Each edition represented the same careful examination of existing information in the light of recent discoveries that characterized the first table

As indicated by the Food and Nutrition Board the recommended dietary allowances are to be interpreted literally that is the data set forth in Table 3 are to be understood as "representing levels of nutrient intakes which the Food and Nutrition Board recommends as normally desirable goals or objectives" It is important to understand that the recommendations are not considered as requirements *The recommendations, in the words of the Board are intended to represent not merely the literal (minimal) requirements of the average individual but levels enough higher to cover substantially all individual variations in the requirements of normal people*

When studies on man have been conducted in which the intakes of certain nutrients are increased above the level which is just sufficient to prevent obvious deficiency symptoms substantial improvements in growth and function have been clearly indicated The allowance of intake above the critical level for each nutrient serves a twofold purpose It permits additional benefits for the individual and it provides a "cover" for individual variations Thus the allowances are in keeping with our present philosophy of "buoyant" health is passable health





TABLE 3—CONT'D

AGE YR	WEIGHT KG (LB)	HEIGHT CM (IN)	CALORIES	PROTEIN GM	CAL C/M	IRON MG	VIT. A IU	THIA MG	RIBO FLAVIN MG	NIACIN MG	AS CORRIC ACID MG	VITA MIN B 1 U
Children	13 16 19 27	(27) (40) (43) (51)	1 200 1 600 2 000	40 50 60	10 10 10	7 8 10	2 000 2 500 3 500	0.6 0.8 1.0	1.0 1.2 1.5	6 8 10	3 50 60	400 400 400
Boys	35 49 63	(78) (108) (139)	2 500 3 200 3 800	70 85 100	12 14 14	12 15 15	4 500 5 000 5 000	1.3 1.6 1.9	1.8 2.1 2.5	13 16 19	75 90 100	400 400 400
Girls	36 49 54	(79) (108) (120)	2 300 2 500 2 400	70 80 75	12 13 13	12 15 15	4 500 5 000 5 000	1.2 1.3 1.2	1.8 2.0 1.9	12 13 12	75 80 80	400 400 400

\*In planning practical dietaries the recommended allowances can be attained with a variety of common foods which will also provide other nutrient requirements less well known. The allowance levels are considered to cover individual variations among normal persons as they live in the United States subjected to ordinary environmental stresses common thereto. (Other nutrients discussed in the text, NRC Bulletin No. 30, include: Fat p. 23, Water p. 23, Sodium Chloride p. 23, Phosphorus p. 24, Copper p. 24, Iodine p. 24, Vitamin B<sub>6</sub> p. 25, Vitamin B<sub>12</sub> p. 25, Folic acid p. 26, Biotin p. 26, Pantothenic acid p. 26, Vitamin K p. 27, Fluorides p. 24 and Other Trace Elements p. 24.)

†These calorie recommendations apply to the degree of activity for the reference man and woman. For the urban "white collar" worker they are probably excessive. In any case the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight.

‡The recommendations for infants pertain to nutrients derived primarily from cow's milk or commercial milk preparations. There should be no question that human milk is a desirable source of nutrients for infants, although intakes may not satisfy the recommended levels of certain nutrients, e.g., protein, calcium, thiamine and riboflavin.

§During the first month of life, desirable allowances for many nutrients are dependent upon maturation of excretory and endocrine functions. Therefore no specific recommendations are given.



Fig 5—The Basic Seven Wheel of Good Eating (Reproduced by permission of the American Institute of Baking)



tive content Therefore, the Basic Seven should include variety within each group as well as the seven groups each day

As each nutrient is discussed throughout the book, its relationship to the Basic Seven will be emphasized The section on planning the adequate diet for the family will be based on the recommendations of the Basic Seven It is important, now, to realize that the Basic Seven is a nontechnical application of centuries of research in nutrition and allied sciences Research is continuing to seek answers to the three questions discussed in this chapter, the basic nutritive needs of the body, how these nutrients function in health and disease, and how much of the nutrients we need for optimum health

### Review Questions

- 1 List some of the ways in which the basic needs of the body are determined
- 2 What is meant by the term "nutrient"?
- 3 How can nutrients function within the body?
- 4 List the specific functions of each nutrient
- 5 What is the difference between the terms ingestion, digestion, absorption and utilization?
- 6 What is meant by the phrase "a dynamic state of affairs"?
- 7 What is the underlying philosophy of the Recommended Daily Allowances?
- 8 What are the uses and limitations of the allowances?
- 9 What is the Basic Seven?

### Suggested Projects

- 1 Record your food intake for one week Carefully note the way in which food is prepared and the portions consumed Be sure to include all food ingested such as chewing gum, in between meal snacks, and sauces This record can be used later in evaluating your nutrition intake
- 2 List the questions and problems you encountered in recording your diet Do you think that the homemaker would have the same problems?

## CHAPTER 3

### THE CARBOHYDRATES

The carbohydrates are organic compounds synthesized by plants. Chemically they are classified into three groups: monosaccharides, disaccharides, and polysaccharides. Carbohydrate foods are an inexpensive source of energy and consequently, form the greatest portion of our diet. Grain grain products, vegetables (legumes, tubers, root vegetables), sugars, syrups, candy, and jellies are all rich sources of carbohydrates. Other sources include fruits and green leafy vegetables. Cooking renders carbohydrate containing foods more accessible to digestive enzymes. Many of these foods supply other important nutrients as well as energy.

The primary function of carbohydrates is to provide energy. Thus they supply the major part of our daily food. In addition, carbohydrates have an important relationship in protein and fat metabolism which will be discussed in Chapter 6. Carbohydrates exist in the body as glucose, a constant constituent of the blood which supplies the cells with energy, and as glycogen which serves as a store of reserve energy.

Chemically they are organic compounds composed of carbon, hydrogen, and oxygen. They are synthesized by plants under the influence of sunlight from the carbon dioxide of the air and water. In plant form, carbohydrates are ingested by the animal and in the animal body are again completely broken down (oxidized) into carbon dioxide and water:  $C_6H_{12}O_6 + 6O = 6CO_2 + 6H_2O$ . They are hydrates of carbon.

Carbohydrates can be classified into three major groups depending upon the complexity of the molecule. The monosaccharides or simple sugars, disaccharides which yield two simple sugars upon hydrolysis, and polysaccharides which yield more than two simple sugars upon hydrolysis or digestion.

#### Monosaccharides—( $C_6H_{12}O_6$ )

Glucose, known also as grape sugar, dextrose, and corn sugar, is found in abundance in fruits and plant juices. Grapes and sweet corn are especially rich sources of this sugar. As corn syrup it has become popular as the carbohydrate for modification of baby food.

## THE NUTRIENTS

mulas, in candy making, jellies, etc. It results from the hydrolysis of other carbohydrates during the course of digestion and is the form in which sugar circulates in the blood. Fructose is known also as fruit sugar and levulose. A mixture of glucose and fructose is present with glucose in fruits and vegetables and serves, as does glucose, as a source of liver glycogen. These two sugars are interconvertible. Galactose results, with glucose, from the hydrolysis of lactose or milk sugar. It, too, may be converted into glycogen. It does not occur free in nature. Compounds of galactose, or galactosides, occur in nervous tissue. Two molecules of galactose combine to form lactose.

The monosaccharides are crystalline, readily soluble, sweet, and are very easily digested.

Disaccharides—( $C_{12}H_{22}O_{11}$ )

Sucrose is ordinary table sugar. It is sometimes called cane sugar or saccharose. It is widely distributed in nature, usually mixed with glucose and fructose, in fruits and plant juices. Commercial sucrose is prepared from either sugar cane or sugar beet. Hydrolysis of sucrose yields one molecule of glucose and one of fructose.

When part of the sucrose has been crystallized from cane sugar or beet syrup, molasses is left. Molasses contains much of the sucrose, the ash, and other constituents of the original syrup. It is of value as a source of iron and has recently been found to be a source of some of the B vitamins.

The chemical structure of maple sugar is identical with that of sucrose. This concentrated sap of the sugar maple tree gains its characteristic flavor from adhering substances. Lactose yields equal parts of galactose and glucose upon hydrolysis. It is the form in which carbohydrate occurs in milk. Commercial lactose is prepared from whey, the by-product in the manufacture of cheese. Milk of all species of animals contains lactose in amounts from 4 to 8%. Lactose is less sweet and less soluble than sucrose. Its chief use is in the diet of infants and invalids. Valtose results from the action of a specific type of enzyme (amylase) upon starch. This action occurs during the germination or sprouting of cereals. Malt, usually derived from barley, is frequently used for its unique flavor as a sweetener of cereal products and in the preparation of malted drinks.

Disaccharides are crystalline, sweet, soluble, and easily digested. If abnormal conditions exist in the gastrointestinal tract, however, the ingestion of disaccharides may result in fermentation and gas formation and acute distress.

Polysaccharides—( $C_6H_{10}O_5$ )<sub>n</sub>, as the formula indicates, yield more than two molecules of simple sugar upon hydrolysis.

Starch is the form in which most plants store their food supply. In fruits this starch is converted into glucose as ripening proceeds, with resulting sweetness. Starch constitutes one half to three fourths of the solid matter of cereal grains. Through starch-splitting enzymes or acid hydrolysis, starch is converted through dextrins and maltose into glucose. Starch is not soluble in cold water, but in hot water it is absorbed and the starch grains swell and rupture.

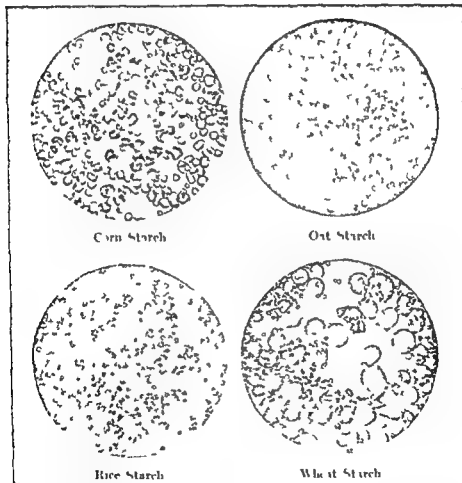


Fig. 6—Starch grain in light in any time. (From Leach and Winton Food Inspection and Analysis John Wiley & Sons Inc.)

Dextrins are intermediate breakdown products between starch and sugar. They are more soluble than starch and are slightly sweet to the taste. Toasting of bread dextrinizes some of the starch with a resulting flavor change. The caramelization of sugar produces a similar reaction.



*Dextrin in solution is sticky, and this property is utilized commercially in the adhesive substance on postage stamps*

Glycogen is frequently called animal starch, since carbohydrate is stored in this form in the animal body. By digestion vegetable starch is broken down into glucose and then rebuilt into animal starch or glycogen in the liver, where it is held for future use. As much as 200 to 300 gm may be stored in the human liver. In addition, glycogen is present in every body cell.

Cellulose is the structural portion of plants. It forms the framework in which the starch granules are deposited. It is insoluble and is not digested by enzymes present in the human gastrointestinal tract, although herbivorous animals are able to utilize it. Cellulose is valuable as roughage, unless contraindicated in gastrointestinal abnormalities. When hydrolyzed with acid, cellulose yields glucose.



Fig 7—Changes of starch grains in cooking. a Cells and starch grains in a raw potato. b in a partially cooked potato. c in a thoroughly boiled potato. (Courtesy United States Department of Agriculture.)

Cellulose is important commercially in the preparation of collodion, celluloid, Cellophane, mercerized cotton, rayon, paper, and lacquers.

Inulin is the starch of dahlia tubers of Jerusalem artichoke, mushrooms, and possibly, to some extent, is found in other vegetables. Inulin is not digestible, and for this reason is sometimes used in diet adjustment.

Agar agar is the hemicellulose (cellulose like material) of seaweed. It has no food value but is used medicinally.

Pectin is the hemicellulose which gives fruits the property of jelling. It occurs in varying amounts, but to the greatest extent in unripe fruit.

The polysaccharides vary in solubility and digestibility. They have little or no flavor, and are amorphous, not crystalline.

In years past, carbohydrates formed the bulk of the normal diet, supplying from 45 to 65% of the total calories. Today, however, they are used less abundantly. Not more than 50% of the calories are usually supplied by carbohydrate. The range

is rather 40 to 50% except in low cost diets where, of necessity, cereals must be used in large amounts. They are bland in flavor, least costly of the foodstuffs, and occur in such variety that they are well adapted to liberal use. Deviation from the range of 40 to 50% of the calories (4 to 5 gm per kilogram of body weight, or a total daily intake of 200 to 400 gm) is at times

## Food Value in a Grain of Wheat

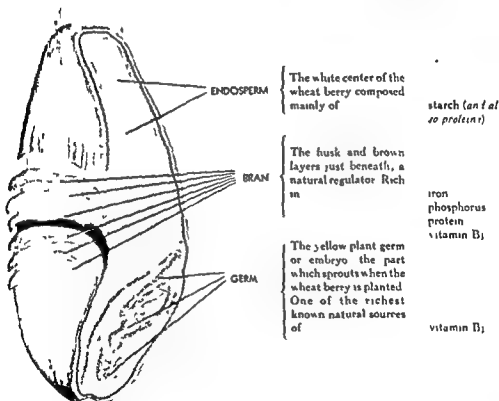


FIG. 8—Food value in a grain of wheat. (Adapted from information supplied by the B-1 Research Laboratory.)

necessary in conditions such as diabetes, hypoglycemia, liver disorders, and epilepsy. Not only do foods high in carbohydrate value supply energy but, in addition, they often provide a varying amount of protein, several minerals, and vitamins. One cannot discuss carbohydrate foods without considering these important additional contributions.

## THE NUTRIENTS

Dextrin in solution is sticky, and this property is utilized commercially in the adhesive substance on postage stamps. Glycogen is frequently called animal starch, since carbohydrate is stored in this form in the animal body. By digestion, vegetable starch is broken down into glucose and then rebuilt into animal starch or glycogen in the liver, where it is held for future use. As much as 200 to 300 gm may be stored in the human liver. In addition, glycogen is present in every body cell. It forms the framework in which the starch granules are deposited. It is insoluble and is not digested by enzymes present in the human gastrointestinal tract, although herbivorous animals are able to utilize it. Cellulose is valuable as roughage, unless contraindicated in gastrointestinal abnormalities. When hydrolyzed with acid, cellulose yields glucose.



Fig 7 Changes of starch grains in cooking. a, Cells and starch grains in a raw potato. b, in a partially cooked potato. c, in a thoroughly boiled potato (Courtesy United States Department of Agriculture)

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## Food Value in a Grain of Wheat

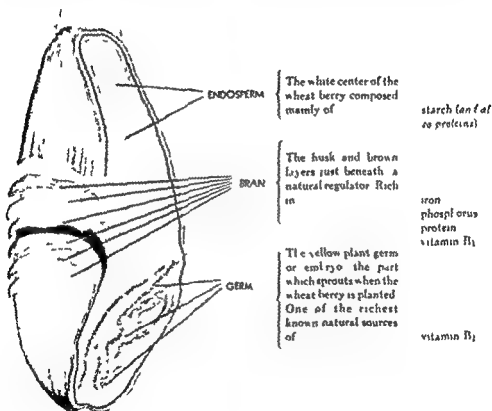


FIG. 11.—Food value in a grain of wheat. (Adapted from information supplied by the National Health Laboratory.)

necessary in conditions such as diabetes, hypoglycemia, liver disorders and epilepsy. Not only do foods high in carbohydrate value supply energy but in addition, they often provide a varying amount of protein, several minerals, and vitamins. One can not discuss carbohydrate foods without considering these important additional contributions.

Carbohydrate food may be considered in four main groups: cereals and cereal products, vegetables, fruits, and "concentrated sweets" Of these, the cereal and cereal products form the largest fraction of the usual diet. This group includes cereal in many forms such as flour, bread, cakes, pastries, dry cereals, and specialized products The choice of cereal may be influenced

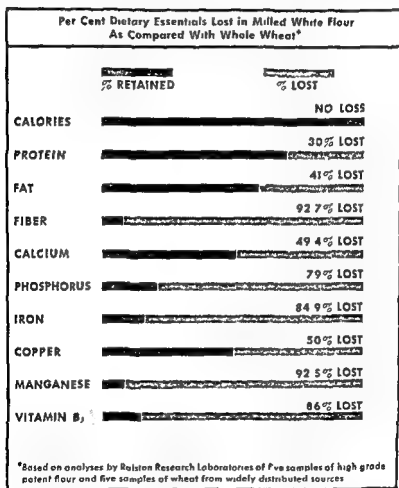


Fig 9 —Dietary essentials lost in milling (Compiled by the Ralston Company)

by ethnic patterns and agricultural possibilities. In the United States, wheat has been reported to furnish approximately 25% of the total calories consumed, whereas, in the Far East, rice normally provides about 70% of the food supply (in terms of calories). Oats and corn are also widely used by the American people

Wheat is approximately 11% water 12% protein 2% fat 71% carbohydrate 2 to 3% cellulose and 2% mineral matter. The character of the protein differs in the cereals the principal protein of wheat is gluten a combination of gliadin and glutenin. Gluten gives wheat flour its peculiar elastic property.

Cereal grains are similar in structure and consist of three parts the bran coat the body of the grain or endosperm, and the germ.

In the process of milling the bran layers and germ are removed. Unfortunately this results in a flour or starch essentially devoid of minerals and vitamins. The following tabulation gives the percentages of protein carbohydrate fat and other constituents in the various parts of the wheat.

	PERCENTAGE				
	PROTEIN	CARBOHYDRATE	FATS	FIBER	MINERALS
Endosperm	10.12	76	1	0.25	0.40
Bran	16	44	3.5	18.0	6.0
Germ	25.40	30.50	8.15	1.8	5.7

Since 1941 under the stimulus of the National Research Council there have been several changes made each of which brings about an increase in the nutritive value of breads and flour.

In the most widely used method the crystalline vitamins are added giving an 'enriched' flour. To be sold as such flour must conform to certain specifications. An "enriched" flour must contain thiamine niacin riboflavin and iron within the amounts given below and may in addition contain calcium and Vitamin D.

The newer standards proposed for enriched flour differ from the original. The increases are designed to keep pace with the changes in the knowledge of dietary needs according to evidence presented by technical authorities (from food industries and representatives of the Food and Nutrition Board of the National Research Council).

The bread enrichment program is a definite step forward in government encouragement for better national nutrition. Enriched bread and flour are unchanged in flavor and compare favorably with the coarser whole wheat products. Without enrichment many more American diets would be low in thiamine riboflavin niacin and iron. In addition bakers may, and many

TABLE 4

ENRICHMENT STANDARDS<sup>1</sup>

(All Figures Represent Milligrams per Pound)

PRODUCT	THIAMINE (B <sub>1</sub> )		RIBOFLAVIN (B <sub>2</sub> )		NIACIN		IRON	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Enriched bread, or other baked products	11	18	07	16	100	150	80	125
Enriched flour*	20	25	12	15	160	200	130	165
Enriched Farinat	166	—	12	—	60	—	60	—
Enriched macaroni prod ucts†	40	50	17	22	270	340	130	165
Enriched noodle prod ucts‡	40	50	17	22	270	340	130	165
Enriched corn meals	20	30	12	18	160	240	130	260
Enriched corn grits§	20	30	12	18	160	240	130	260
Enriched milled white rice¶	20	—	**	—	160	—	130	—

<sup>1</sup>The Roche Review of Enrichment Requirements (Courtesy Hoffmann-LaRoche Inc Nutley New Jersey)

The maximum and minimum levels shown above for enriched bread enriched flour enriched Farina enriched macaroni spaghetti and noodle products enriched corn meal and corn grits are in accordance with Federal Standards of Identity or State laws. Act No 183 of the Government of Puerto Rico requires the use of enriched flour for all products made wholly or in part of flour. This includes crackers pretzels etc.

The levels of milled white rice are officially those of the Government of Puerto Rico. These levels are commonly accepted in United States domestic and export marketing and are based on the recommendation of the Committee on Cereals Food and Nutrition Board National Research Council.

\*In enriched self rising flour calcium is also required between limits of 500 to 1500 mg per pound.

†No maximum levels have been enforced.

‡Levels allow for 30 to 50% losses in kitchen procedure.

§Levels must not fall below 85% of minimum figures after a specific rinsing test described in the Federal Standards of Identity.

¶Levels must not fall below 85% of levels shown after washing and rinsing.

\*\*Omitted in the United States and Puerto Rico but used in certain Far Eastern countries to a minimum level of 12 mg per pound.

do, add milk solids, wheat germ, or soya flour. The addition of milk solids improves the protein quality, adds calcium, ribo flavin and improves flavor. The combination of vitamin and milk enrichment is highly desirable. At the beginning of 1954 twenty six states, Hawaii, and Puerto Rico had enacted bread and flour enrichment laws (Alabama Arkansas, Colorado, Georgia Indiana, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Mississippi, Nebraska New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Rhode Island South Carolina, South Dakota, Texas, Washington, West Virginia and Wyoming).

The Puerto Rican law is unusual in that it requires wheat flour and all products made from it to be enriched.

Bread is 60% flour. The thiamine, niacin and iron in yeast breads are but slightly affected by baking. A pound loaf of bread yields eighteen slices.

Graham flour is the whole wheat kernel ground.

Intine wheat flour (contrary to what the name would indicate) is prepared from wheat minus some of the five or six outside bran layers.

Macaroni, spaghetti and vermicelli are prepared from wheat with a high gluten content. Although enrichment of these products is not required in any state, there is quite a trend on the part of macaroni and spaghetti manufacturers now to enrich their products.

Corn is similar in structure to wheat but differs in its protein. The proteins of corn are zein and glutelin. Corn contains less protein, minerals and cellulose than wheat but has more fat and carbohydrate. Since the cellulose of corn is low (17%) only the outer skin need be removed before milling. There are several states which have laws regarding the enrichment of corn meal products and are mandatory in so far as degerminated meal and grits are concerned. These states are Alabama, Georgia, Mississippi, North Carolina and South Carolina. This represents a progressive step in public health for corn meal is a staple of the diet in this area.

Cornstarch and corn syrup are prepared from the endosperm of the corn, the first by fine grinding and the second by hydrolysis of the cornstarch by dilute acid.

Rice, another staple in the diets of some ethnic groups, is not affected by either State or Federal standards for enrichment. However, it is possible that specifications will be adopted shortly. Puerto Rico does have an enriched rice law and there seems to be a trend among some manufacturers to enrich rice. The Philippines, which are no longer a United States possession, have taken action toward rice enrichment.

Today, numberless cereal products are available: puffed, flaked, kernels finely ground and others. All have their place in the diet and all lend variety. Labels should indicate the composition. Recently, manufacturers have added vitamins or minerals or have irradiated their products. The ready-to-serve, packaged and fortified cereals are naturally the more costly, and certain preparations have a slightly lower nutritive value due



to the high heat used in their preparation, than the original grain. Dry cereals do not seem to be covered by any State or Federal enrichment laws. However, whenever any product makes a vitamin claim (which is the case with some of the dry cereals), it is immediately classified as a special dietary food and is thereby subject to the Food and Drug Administration's label regulations. To meet these, a declaration of the vitamin content and a statement of the percentage of minimum daily requirement supplied by the recommended daily portion of the food must appear on the label.

The statement is occasionally made that oatmeal causes rickets. A brief explanation may be in order. Cereals do contain phytic acid, which has the power to combine with calcium thus converting the calcium into a nonutilizable form (a phytate). Cereals also contain an enzyme phytase which can hydrolyze this phytate. The amount of the phytase present in cereals is variable. Oats have little, wheat much more and rye more than wheat. Long cooking, as in the cooking of old fashioned porridge destroys this enzyme thus preventing its normal action of breakdown of the phytate and release of the calcium. The shorter cooking time coupled with the higher content of enzyme in other grains results in greater release of calcium. Therefore the studies which showed that rickets could be produced on a diet containing a large amount of oatmeal gave rise to a popular misinterpretation of facts. Practically, it is not of importance for human beings who eat diets of variety rather than subsisting almost entirely on the old fashioned oatmeal. Not only do cereals contribute the bulk of the calories in the diets throughout the world but through enrichment and natural sources they supply some protein and several B vitamins (primarily thiamine, riboflavin and niacin) and the important minerals iron and calcium.

Within the last several years a second type of enrichment has come about. The idea was the brain child of McCray at Cornell who with Flick and Silva developed a new bread formula known as the Cornell formula. To enriched unbleached flour is added 2% wheat germ, 6% full fat soy, and 8% powdered skim milk. The result is a delicious flavored good textured excellent toasting bread at a cost of approximately one cent a loaf more than the standard white bread. The only requirement for any

one desiring to use the formula is that the ingredients as indicated above be clearly listed on the wrapper. The formula is open—a statement of ingredients by ‘open formula’—giving the consumer protection which is a desirable trend. The minimum basic ingredients of breads is controlled by Government regulation. Additions are justifiably held as ‘trade secrets’.

The vegetables may be divided into three main classes: legumes, root and tuber, and green leafy. Each group varies in starch, sugar, protein, mineral, and vitamin content. In the past vegetables were subdivided according to their carbohydrate content into 5, 10, 15, 20% vegetables, indicating that 5, 10, 15, 20 gm of carbohydrate is contained in 100 gm or in approximately  $\frac{1}{2}$  cupful of vegetables. Even another grouping has been 3, 6, 12, 15, 18% vegetables. The composition is variable with the soil on which they are raised, variety, season, and handling, and these divisions are therefore only *approximate*. Such grouping will be found in the Appendix. However, the recent trend is to have two main groupings of vegetables and accept an average value as the carbohydrate content in each group. Group A which contains *negligible* amounts of carbohydrate when used in reasonable amounts, and Group B which contains *approximately* 7 gm of carbohydrate per average serving of  $\frac{1}{2}$  cup (100 gm). A discussion of this new approach will be found in Chapter 30.

The legumes include such vegetables as dried navy and kidney beans, green or dried lima beans, green or dried peas, and lentils. In addition to their high carbohydrate value, these foods are important sources of proteins. The quality of this protein and its place in the diet will be discussed later. The legumes may also contribute thiamine, small amounts of riboflavin, and some iron to the diet. Some ascorbic acid may be found in fresh legumes.

The second class of vegetables, and the one which ranks second in carbohydrate value, is the roots and tubers. Chief among these is the potato. According to the U. S. Department of Agriculture, the per capita consumption of white potatoes is 120 pounds per year. Potatoes are high in starch and consequently caloric value and are of low fiber content. They also may be considered as a moderate source of iron, ascorbic acid (in fall and early winter), and thiamine. The sweet potato ranks second in vegetable consumption in the United States. In comparison,

it is higher in carbohydrate value than the white potato, and it may be considered as a rich source of vitamin A. It contributes some thiamine, ascorbic acid (which is lost during storage), and iron. Other commonly used root vegetables are carrots (rich in carotene), turnips, and beets.

While not of this classification, the squash, Hubbard acorn, or butternut, provides a carbohydrate value similar to that of the root vegetables. In addition, these squashes are rich in carotene.

The third class of vegetables, the leafy, includes such plants as cabbage, kale, chard, broccoli, spinach, turnip greens, collards, lettuce and beet greens. These vegetables are relatively low in carbohydrate. However, as a group they are outstanding sources of certain minerals and vitamins. Calcium and iron are the minerals supplied and these foods are all excellent sources of vitamin A or, rather, carotene (the substance from which vitamin A is formed). Roughly, the degree of potency of carotene corresponds to the depth of color found in the leafy vegetables. In the fresh state, the leafy vegetables are rich sources of vitamin C. However, as will be discussed later, much of this vitamin, which is initially present in some vegetables, is lost during handling and cooking.

Tomatoes, botanically a fruit, take their place in the American dietary as an important vegetable. This importance is due to two factors: one, their excellent nutritive value, and, two, the fact that they rank third among vegetable consumption. The tomato in its various forms ranks first in canned vegetable consumption. Although the tomato is low in carbohydrate value, it is a good source of ascorbic acid. The acidity of the tomato protects this vitamin against any considerable loss in cooking. Although containing some carotene and some B vitamins, the tomato is not considered an important source of these nutrients.

Fruits may likewise be grouped according to carbohydrate content. Some fruits like bananas, dates and figs have high fuel value. Others like watermelons, pears, strawberries and rhubarb have low caloric value. In general, fruits have less than 2% protein and except for avocados, pears and olives have less than 2% fat. Their carbohydrate content varies from 5 to 20% in the fresh fruits and from 60 to 80% in the dried fruits.

Fruits owe their distinctive flavors to the volatile oils and acids. The malic acid in apples, tartaric in grapes, citric in lemons, oxalic in tomatoes are formed in the breakdown of the

starches. Fruits are valuable in preserving the alkalinity of the blood, since they form alkaline carbonates during the digestive process. During the ripening of fruits, the starch is converted into sugars, at which time they become readily digested.

Fruits are rich sources of vitamins and minerals (see discussion under these headings). Their carbohydrate content varies according to the form in which fruits are purchased and consumed. Fruits are available in the fresh state, canned in sugar syrup or water, dried, stewed, frozen and preserved. Fruit juices also form a major part of the American diet pattern. Not only does the carbohydrate content vary according to the processing the fruit receives, but the nutritive value is also affected.

Although fresh fruits do not contribute appreciable amounts of carbohydrate (they are roughly 10%) dried fruits, "syrup pack" and frozen fruits (which are usually packed with sugar) are doubled and sometimes tripled in carbohydrate, hence, fuel value. For the most part the vitamin and mineral values of dried fruits are appreciably more than those of fresh fruits, whereas the nutritive value of canned fruits is somewhat lower. The vitamin and mineral values of frozen fruits seem to be slightly lower than the fresh and approximately the same as the canned fruits. As mentioned previously, the vitamin and mineral content of fresh fruits and vegetables can vary considerably according to the method of handling.

As a group, fruits are important sources of ascorbic acid, certain of the B complex, vitamin A, iron, and some other minerals. The citrus fruits are exceptionally rich in ascorbic acid and cantaloupe, strawberries and apples (to a lesser extent) are also good sources of this vitamin. Apricots, yellow peaches and cantaloupe contribute vitamin A to the diet. A discussion of the contribution of fruits to enhance the vitamin and mineral values of the diet will be presented in respective chapters.

Obviously, jams and jellies made from fruits and sugar are concentrated carbohydrate foods. By the time the fruit has undergone the preparation and cooking process, in addition to "dilution" with sugar, the vitamin value has been markedly reduced. Since such foods have little more than caloric value, they should not be permitted to crowd out foods which will supply not only calories but vitamins and minerals as well.

TABLE 5  
COMPARATIVE AMOUNTS OF CARBOHYDRATES IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBO HYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Apple (raw)	0.3	0.4	14.9	0.3	84.1	58
Banana	1.2	0.2	23.0	0.8	74.8	88
Dried prune (un cooked)	2.3	0.6	71.0	2.1	24.0	268
Orange juice	0.8	0.2	11.0	0.4	87.5	44
String bean (cooked)	1.4	0.2	4.7	1.3	92.5	22
Dry navy bean (raw)	21.4	1.6	61.6	3.9	11.5	338
Celery (raw)	1.3	0.2	3.7	1.1	93.7	18
Spinach (cooked)	3.1	0.6	3.6	1.9	90.8	26
Carrot (raw)	1.2	0.3	9.3	1.0	88.2	42
Potato (baked)	2.4	0.1	32.5	1.2	77.8	83
White bread	8.2	3.3	52.3	1.7	34.5	276
Toasted white bread	9.7	3.7	59.0	2.1	25.5	313
Oatmeal (cooked)	2.3	1.2	11.0	0.7	84.8	63
Cornflakes	8.1	0.4	85.0	2.9	3.6	385
Sugar (granulated)	—	—	99.5	—	0.5	385
Candy (fudge)	1.7	11.8	81.3	0.7	5.0	411
Molasses (medium)	—	—	60.0	8.5	24.0	232
Jelly	0.2	—	65.0	0.3	34.5	252

Adapted from U. S. Department of Agriculture Handbook No. 8 Composition of Foods Raw Processed Prepared

Nuts properly belong to the fruit group but because of their composition are discussed in the chapter on Fats.

The major difference between fruits and vegetables is that of the form in which the carbohydrate exists. In fruits—in the ripened stage—the carbohydrate is sugar, in vegetables it exists as a starch. In addition, most fruits have a mild laxative action. These differences may be used clinically but have no significance in the normal diet.

When one reviews the basic function of each part of the plant the relative carbohydrate value is clear. For example, the leaves which are commonly referred to as the "manufacturing part of the plant" are high in cellulose structure and low in carbohydrate value. Spinach, kale, and cabbage will be found among the 3% vegetables. On the other hand, the root serves as a "storage house" for the plant. There one will find a relatively high carbohydrate value. As the plant matures, the concentration of carbohydrate increases. This may be illustrated by the difference between "new" potatoes and "old" potatoes, "young"

carrots and "old" carrots. The stalk of the plant is called the "roadway" and consequently has little carbohydrate value. Celery, rhubarb and asparagus are examples of this part of the plant. Similarly the flower having no need to store food for the plant is low in carbohydrate. The cauliflower, Brussels sprout and broccoli are from this part. The fruit of the plant represents the food which the seed needs to begin life and consequently is high in carbohydrate. Like the root, as the plant matures the fuel value increases. Most fruits are found in this category as well as a few vegetables and the cereals. Of course there are many exceptions to this classification but such a grouping may serve as a guide in recalling the relative carbohydrate content of foods derived from plants.

The fourth group of carbohydrate foods may be called "concentrated sweets" and includes such items as sugars, syrups, molasses, honey, candy and sweetened beverages. The consumption of sugar in the United States is high, an estimated 100 pounds per capita or  $\frac{1}{2}$  pound per day per person. White sugar and its products, frostings, candy and syrups are highly concentrated carbohydrates. Others of this group such as brown sugar, corn syrup, maple syrup and maple sugar contribute small amounts of calcium and iron. Honey contains a small amount of some members of the B complex and some vitamin C. Molasses is an excellent source of both calcium and iron. Except in the case of molasses the nutrients other than carbohydrate are so small that the contribution is negligible. Blackstrap molasses is defined as the dark, thick syrup remaining after the economic exhaustion of crystalline sugar (sucrose). In recent years many extravagant claims have been made in relation to its therapeutic value which have no basis in scientific investigation. The nutritional value it contains is potassium and magnesium (both of which are plentiful in the average diet), some calcium and some iron and copper. The latter two are usually in the form of insoluble compounds which therefore have no food value. Blackstrap molasses seems to have considerable quality as a laxative.

The purpose of cooking food is to improve palatability and render it more easily and completely available to the digestive enzymes. Carbohydrate foods are no exception. In starch foods cooked in moisture such as cereals and starchy vegetables (po

tatoes), the encasing membrane of the starch molecule swells and ruptures (see Fig. 7), a process known as gelatinization. Cooking of vegetables dissolves the intercellular material which binds the cells of the cellulose together. This serves the dual purpose of softening the cellulose structure, thereby increasing its palatability and rendering the carbohydrates, minerals, and vitamins more available to the digestive process. For the most part, the cooking of fruits and sugars serves to enhance the palatability rather than to improve the digestibility. Correct vegetable and fruit preparation is also concerned with the retention of vitamins and minerals which will be discussed later (see Chapters 11, 12, and 13).

### Review Questions

1. What are the carbohydrates chemically?
2. Into what main groups are they classified?
3. Into what classification should the following be placed: glycogen, lactose, corn syrup, cellulose, honey, cane sugar, dextrins, pectin, agar agar?
4. Approximately what percentage of the normal diet is furnished by carbohydrates?
5. What is an "enriched" flour or bread?

### Suggested Projects

1. From your menus (your diet record of one week), list the carbohydrates you included. Classify them according to the four main groupings set forth in this chapter. Determine the percentage each group contributed to your total carbohydrate intake.
2. From your menus, using the tables of food composition in the Appendix, calculate your average daily intake of carbohydrate. Is it too high? Too low? Why? Can you change your dietary pattern so that your intake of carbohydrate will equal your needs?
3. What are the ten cheapest sources of carbohydrate on the market now? What is their relative cost?
4. Find an advertisement in which the carbohydrate of the product is mentioned. Analyze the copy with respect to the information set forth in the previous discussion.
5. Plan a low cost diet for one day that will provide an adequate 2,100 calorie diet. What carbohydrates did you use?
6. If you needed to restrict your energy intake, which carbohydrate foods would you include? Which would you omit? Why?

## CHAPTER 4

### THE LIPIDS

Lipids are organic compounds which, for the most part, are synthesized by animals from plant sources. Vegetable oils are usually found in the seed. Because of the chemical composition and combination fats are a concentrated source of energy. Outstanding fats found in the normal diet are butter, oleomargarine, cream, some cheeses, meat fats, and salad dressings. "Hidden fats" may be gravies, avocados, and nuts. Fats are an important constituent of the diet for both the energy and satiety value.

The term 'lipids' has been suggested by Bloor to include fats and other compounds which resemble them in physical properties. Although members of this group have certain solubilities and properties in common for the most part they are diverse in their chemical constitution.

The fats, the lipid with which this chapter is primarily concerned, are organic compounds of carbon, hydrogen and oxygen, as are carbohydrates. However, because fats contain less oxygen and more carbon than carbohydrates, fats are a more concentrated fuel and require more oxygen when it burns or oxidizes. Consequently fats contribute two and one fourth times as many calories per given weight as do carbohydrates.

Fat is stored in considerable amount in animal tissue (referred to as adipose tissue) where it serves as the reserve fuel supply in a fashion similar to carbohydrate storage by the plant. To a lesser extent fat occurs in plants where it is usually stored in the germ portion. The layers of fat may serve as a protection against mechanical injury. Fat also acts as padding and support for the organs and as an insulation against rapid body temperature change. In addition to "depots" of body fat, lipids are found in other areas of the body such as plasma lipids (phospholipids, cholesterol and cholesterol esters) and as constituent of cells. While not so effective as carbohydrate in this role, fat has a protein sparing action.



Blood classifies the lipids as

1 Simple lipids : Esters of fatty acids and alcohols

- a Fats, esters of fatty acid with glycerol. The familiar animal and vegetable fats belong to this group
- b Waxes, esters of fatty acids with an alcohol other than glycerol, for example, beeswax, wool wax, spermaceti, etc

2 Compound lipids : Esters of fatty acids containing groups in addition to the fatty acid and alcohol radicals

- a Phospholipids, containing, in addition, phosphoric acid and nitrogen. Lecithin a necessary constituent for cell life, belongs to this class. It is found in egg yolk, milk, brain, bile, nerve tissue, and other animal tissues
- b Sterols, large molecular alcohols combined with fatty acids, as for example, cholesterol and ergosterol. Cholesterol, one of the animal sterols, is widely distributed in nature. It is a constituent of bile, being held there in solution by the bile salts. Its presence in cells gives to them the property of holding water. Ergosterol is a characteristic sterol of plant life. When irradiated, it is known as calciferol which, when dissolved in oil, is commercially known as Viosterol or vitamin D<sub>2</sub>.

Animal sterols can also be irradiated and when dissolved in oil are known commercially as Delesterol or vitamin D<sub>3</sub>.

The compound lipids are known as lipoids. They are fatlike substances but are more complex than the true fats—hence, are more reactive. Active body tissue contains fat in this form.

Other groups are of lesser importance and need not be discussed here.

As indicated above, the fats are simple esters of glycerol and fatty acids and are named according to this fatty acid molecule, as stearin from stearic acid and olein from oleic acid. The hardness of any fat is determined by the fatty acid in combination with the glycerol. Natural fats are mixtures rather than just pure fats so this hardness or consistency, which is related to the melting point of the fat, is not sharp. The fats range in firmness from the oils to fats of extreme hardness. It should be emphasized that the term "oil" in this instance refers to the physical state of a fat (meaning liquid fats) rather than its chemical nature. (Chemically speaking, an oil may refer to the hydrocarbon oil derived from petroleum, such as mineral oil or lubricating oil.)

Certain fats and oils (liquid fats) are unsaturated, that is they have double bonds capable of opening and receiving other radicals. Such fats are soft in texture but may be hardened by the addition of hydrogen (a process known as hydrogenation).

The double bonds open and receive hydrogen ions and thereby become solid substances. Advantage is taken of this process in the hydrogenation of cottonseed oil to form many popular short enings.

Fats so saturated do not become rancid as do fats in the unsaturated state a point of practical importance. The rancidity of fats is due to a partial oxidation of the unsaturated groups hydrolytic changes and bacterial action. Such changes decrease both the palatability and vitamin value. The degree and speed of rancidity vary with individual fats.

Recent experimental studies indicate that some unsaturated fatty acids are indispensable to good nutrition. They are essential fatty acids and are either not synthesized or not synthesized rapidly enough in the animal body to permit their omission from the diet. The exact function of the unsaturated essential fatty acids is not fully known but it has been suggested that they are needed as actual structural materials. Some research has indicated that a deficiency of the essential fatty acids will result in skin lesions in the dog and the rat and as an eczema in man. These essential fatty acids are linoleic acid (with two double bonds) linolenic acid (with three double bonds) and arachidonic acid (with four double bonds). They are present in such food fats as soybean, whole wheat, unhydrogenated cottonseed oil (Wesson), corn oil (Mazola), peanut, linseed and olive oils and in egg yolk and to a lesser extent in lard. Fats other than these essential fatty acids can be synthesized in the body from protein, carbohydrate and other fatty acids. Recent work suggests that the concept of need for the three essential fatty acids may change. There is indication that linoleic may serve as a precursor of the other two.

The characteristic flavor of food fats is due to foreign substances which are either absorbed from their natural environment or to substances which are produced during processing. For example, the bacterial flora of cheese and butter are carefully controlled so that the desired flavor is produced.

Although fats are insoluble in water, they can form satisfactory emulsion dispersions in water. An emulsion is a suspension of one finely divided liquid in another one. How permanent this suspension will be depends upon how finely the first liquid is broken up and second upon the presence of a third substance

which will prevent the fat globules from running together. This substance is known as an emulsifying agent. Soap, gum arabic, or protein itself (as found in milk and egg yolks) serves as an emulsifying agent.

As the digestion of foodstuffs will be discussed later (Chapter 6), it is sufficient to point out that fats in an emulsified form, like egg yolk, cream, and milk, are more accessible to digestive enzymes than foods with the fat occurring in larger particles. In addition, fats with low melting points are more readily digested than those with high melting points. The fats are changed into their component parts, fatty acids and glycerol (glycerin), through the action of digestive juices (see Chapter 6). This splitting by hydrolysis is called **saponification**. If alkali is present at this time, it reacts with the free fatty acid to form salts or soaps.

As indicated previously, fat in the diet fulfills four major functions: (1) it serves as a source of energy as it is a concentrated form of fuel, (2) it adds flavor and zest to the diet, (3) fat foods because of their "stick to the ribs" value (which is discussed in Chapter 6) add satiety to the menu, and (4) fats are carriers of fat soluble vitamins and essential fatty acids.

The chemical structure of fat, carbon hydrogen oxygen, indicates that it can be completely oxidized to carbon dioxide and water either in the body or in the bomb calorimeter. In addition to its value in heat, 93, or roughly 9 calories per gram, fat is important as a carrier of the fat soluble vitamins A, D, E, and K. Animal fats are important sources of vitamins A and D, vegetable fats as sources of vitamins E and K (see Chapter 11). Thus the fuel value of all fats is approximately the same, even though the nutritive value may be different.

The fat content of a meal influences its time in the stomach, and for this reason fat may be used to control hunger pangs. A meal moderately high in fat has greater satiety value, it is more satisfying because it "stays by" longer than a meal low in, or devoid of fat. This is a point to be remembered in planning certain diets.

In appraising the long term trends (approximately forty years) of food consumption Dr. Esther Phippard reported (1952) that there has been a steady but significant trend toward fewer calories. However, there has been a steady increase in the share

of the total calories derived from fat. The slight increase in grams of fat consumed per capita, coupled with the decrease in the total caloric intake, has resulted in a marked increase in the per cent of calories from fat, namely, from about 32 to 40%. Estimates of the **daily consumption** of fat range from 50 to 100 gm. It has been suggested that it is desirable to include from 25 to 40% of calories in the form of fat. This level is supplied by a range of 1 to 2 gm per kilogram of body weight, or a total of 75 to 150 gm of fat. Perhaps one of the factors bringing about the gradual increase of fat in the diet has been due to the emphasis upon protective foods, the leafy vegetables, in particular, which require salad dressings or butter, and the shift to higher priced foods such as eggs and meats which contain fats.

The foods rich in fat may be divided into two main groups, the animal and vegetable fats. Few foods contain solely fat and, for the most part, protein, some carbohydrate, and the fat soluble vitamins are found in foods rich in fat. The **animal fats** include meat, fish, poultry, egg yolk, milk and milk products, and pure animal fats. To the latter group, the **vegetable fats**, belong the seed and vegetable oils in their natural state, when hydrogenated into lard substitutes or when churned with milk to make margerines for butter substitutes.

A second grouping of fats is sometimes used. This is referred to as "**visible**" and "**invisible**" or "**hidden**" fats. The visible fats include such foods as butter, cream, lard, and salad dressings, while the hidden fats may be designated as the fats of meats, milk, cheeses, butter in cake and pastries, and eggs and nuts.

The **fat content of meats and fish** varies (see Chapter 5). Fat is stored in the cell walls of the connective tissues, around the internal organs, between the muscle fibers, and directly under the skin. The degree of hardness which is characteristic of each species is dependent upon the fatty acid content. There is considerable variability in the fat content of the various commercial cuts of a meat such as beef or lamb. There is also a variability in the fat content of various meats as the percentage of fat is approximately 10% in a lean cut of pork to 80% in salt pork. Meat from which all visible fat has been removed still contains 6% fat.

In fish, the fat is deposited largely in the flesh. Usually a light or "white" flesh in fish indicates a low fat content, while a dark flesh suggests a high percentage of fat. Haddock and cod are always low in fat, while the fat content of most fish varies with the season. For the most part, fish store energy as fat in their livers instead of glycogen which is found in the livers of other animals. Such fish as tuna are frequently canned in oil which would supply additional fat.

The fat content of poultry varies considerably. Duck, goose, turkey, and fowl are higher in fat than the broilers. Breast meat of poultry is lower in fat than leg meat.

Meat, fish, and poultry contribute nutrients other than fat to the diet, primarily protein, the fat-soluble vitamins, some of the B complex, and several minerals.

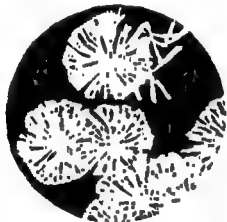


Fig 10.—Beef fat (From Hawk and Bergelm: Practical Physiological Chemistry, The Blakiston Co.)

Egg yolk contains approximately 30% fat in the form of an emulsion. Associated with these fats are other lipids (or fatlike substances), lecithin and cholesterol. The relationship of cholesterol to its metabolism in the body will be discussed in Chapter 39. Recent experiments indicate that the presence of lecithin stimulates the rate of absorption and the extent of digestibility of fats. It has been suggested that this is due to its emulsifying action, in which case it is logical to expect enhancement due to homogenization of milk. Mineral salts, iron, and the fat-soluble vitamins A and D plus thiamine and riboflavin are also present in egg.

Although milk contains only 4% fat, a considerable amount of fat in the diet comes from milk and milk products

Cream is the concentrated fat of milk. It is removed from the milk by various methods of separation, usually by centrifugal force. The degree of separation is expressed as percentage in commercially marketed cream—20, 30, and 40% cream. The terms 2, 3, or 4 X—light or coffee, medium, and whipping cream, are also used. By means of a separator it is possible to concentrate the fat to 60%, and, by churning, to 85% (butter). In addition to fat, cream contributes vitamin A to the diet.

Butter is prepared by churning cream, a process which results in the coalescence of the fat globules. Butter is actually concentrated cream, and contains 85% fat. It may be prepared from either sweet or sour cream, and is marketed in salted and unsalted forms. Salted butter made from sour cream is the more common form. Butter is also rich in vitamin A value.

Cheese supplies appreciable amounts of fat, depending upon the type of basic milk. "True" cottage cheese, a skim milk product, contains only 1% fat. However, many commercial concerns add cream to cottage cheese to increase its acceptability. Full cream cheese, cheddar or Swiss cheese may contain as high as 35% fat.

Lard, suet, and tallow are the fats of pork, beef, and mutton. Rendered free from connective tissues, they may be prepared as pure fat.

As indicated previously, vegetable fats are the second large group which contribute fat to the diet. These fats may be used in either a liquid or solid form. Many oils that are obtained from seeds, such as cottonseed or from corn, are used in salad dressings. Olive oil, which is pressed from the fruit of the olive tree, is an expensive yet popular constituent of salad dressings.

Hydrogenated fats, which were discussed previously, are usually made from the oils of cottonseed, corn, soybean, and peanut. These are primarily used in pastries, cakes, and as a fat in frying.

Other vegetable foods which are relatively high in fat content are chocolate and cocoa. As fruits, avocados and olives contribute fat to the diet.

Nuts are rich sources of fat and protein and, except for chestnuts, are poor sources of carbohydrate. Nuts are good sources

## THE NUTRIENTS

TABLE 6  
COMPARATIVE AMOUNT OF FAT IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBO- HYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Butter	0.6	81.0	0.4	2.5	15.5	716
Margarine	0.6	81.0	0.4	2.5	15.5	720
Lard	0	100.0	0	0	0	902
Peanut butter	26.1	47.8	21.0	3.4	1.7	576
Walnut	15.0	64.4	15.6	1.7	3.3	654
Olive oil	0	100.0	0	0	0	884
Mayonnaise	1.5	78.0	3.0	1.5	16.0	703
French dressing	0.6	35.5	20.3	4.0	39.6	394
Cream (light)	2.9	20.0	4.0	0.6	72.5	204
Bacon (broiled)	25.0	55.0	1.0	6.0	13.0	607
Hydrogenated fats	0	100.0	0	0	0	884

Adapted from U. S. Department of Agriculture Handbook No. 8 Composition of Foods Raw Processed Prepared

of copper, iron, and manganese, and contain B vitamins. Peanuts contain 50% fat and 30% protein, Brazil nuts, 65% fat and 23% protein, and pecans, 73% fat and 9% protein. The water content of nuts is low.

Although margarine manufacture in this country had its beginning about 1875, the scarcity of butter during World War II led to an increased use of margarine as a spread, in seasoning, and in baking. Now it is a large industry. At first, margarine was made from animal fats, chiefly oleo oil from beef suet, but now vegetable oils, primarily cottonseed and soybean oils, are used almost exclusively. The oils are hydrogenated, mixed with pasteurized and cultured skim milk until an emulsion of milk in oil (which is margarine) is obtained. It is then salted and packaged. Most margarines are fortified with vitamin A and some have vitamin D added. In addition, many brands have been colored and are packaged to resemble butter.

One brand of margarine lists its composition as shown in Table 7.

Usually fats are unaffected by cooking procedures such as baking, steaming, and boiling. However, in frying, the cooking of food in hot fat, the temperature is of utmost importance. The improper heating of fats may result in a thin, bluish white smoke rising from the surface. The temperature at which this occurs is called the smoking point of the fat. This indicates that a decomposition is taking place, producing substances among which

TABLE 7

INGREDIENT	PERCENTAGE	WHY USED
American cottonseed oil	80.0	An excellent energy food
Cultured skim milk	16.5	The fresh pasteurized and cultured skim milk which helps give it a delicate appetizing flavor
Salt	2.8	To impart the proper seasoning
Derivative of glycerine	0.5	This product helps make it practically nonspattering when used in pan frying
Vegetable lecithin	0.1	Reduces "sticking to the pan" in pan frying
Benzote of soda	0.1	A preservative. Helps retain its fine fresh flavor
Vitamin A—15,000 units USP per pound		To make it a reliable year round source of this important vitamin
Diaceyl		An artificial flavor. Enhances the flavor and aroma

are fatty acids and glycerol. If the temperature is allowed to increase, a substance called acrolein is formed from the glycerol. Acrolein is acrid in odor and irritating to the eyes. If food has been cooked in overheated fat it may be irritating to the gastrointestinal tract as well.

Smoking point temperatures, i.e. the point at which decomposition takes place, vary. For example, the cottonseed and corn oils break down at  $222^{\circ}$  to  $232^{\circ}$  C, the hydrogenated fats at essentially the same level  $219^{\circ}$  to  $232^{\circ}$ . Lard undergoes change at a lower level  $214^{\circ}$  to  $221^{\circ}$  and if the lard has been reused a number of times at even a lower temperature of  $190^{\circ}$ . The value for butter is given as  $208^{\circ}$  for olive oil  $167^{\circ}$  to  $175^{\circ}$ , and for peanut oil  $150^{\circ}$  to  $160^{\circ}$ . Cooking charts which are carefully worked out as to temperature should be followed.

### Review Questions

1. What is the difference between the terms "fats" and "lipids"?
2. What are fats chemically?
3. How are fats classified?
4. What is meant by an unsaturated fat?
5. What are the "essential fatty acids"? Why are they so named?
6. What is the caloric value of fat per gram?
7. In addition to its energy value, why is fat an important constituent of the dietary?
8. Are margarine satisfactory substitutes for butter?
9. What percentage of the dietary should be provided by fat?
10. What are the important sources of fat in the dietary?
11. Differentiate between hidden fats and visible fats.



### Suggested Projects

- 1 From your menus (your diet record of one week) list the fats you included. Classify them according to the main groupings set forth in this chapter. Determine the percentage each group contributed to your total fat intake.
- 2 From your menus, using the table of food composition in the Appendix, calculate your average daily intake of fat. Is it too high? Too low? Why? Can you change your dietary pattern so that your intake of fat will equal your needs?
- 3 What hidden fats did you include in your diet? What per cent of the total fat intake do they represent?
- 4 What are the ten cheapest sources of fats on the market now? What is their relative cost?
- 5 If you needed to restrict your energy intake, which fats would you include? Why? Which would you omit? Why?
- 6 List your favorite foods. How many are rich in fat content?

## CHAPTER 5

### THE PROTEINS

Protein one of the most important of the nutrients nourishes the body in three ways as a source of energy as material for growth and upkeep and as a regulator of body processes. Proteins are important in relation to their constituent amino acids. Some of these amino acids are classified as essential as they cannot be synthesized by the body. Meats vegetables legumes milk and mill products all provide amino acids. Current research is directed toward the sources and amounts of specific amino acids.

One of the most important of the foodstuffs necessary for the maintenance of life is protein. The word has a Greek derivation and means to come first. Protein is usually the first nutrient considered since every living cell contains and must have a continuous supply of protein if its life is to be maintained. Protein forms a large part of the solid matter of animal tissue (15 to 20%). In the plant kingdom while protein occurs less abundantly than does carbohydrate it still is an important constituent. In fact it is the plant which supplies the original source of the animal protein. The plant in some manner peculiar to itself combines carbohydrates (which it synthesizes from carbon dioxide and water under the influence of sunlight) with ammonia or nitrogenous compounds in the soil to form protein. While animals can rebuild protein in their tissues they cannot produce it from simple inorganic inanimate substances which have never lived. Through the ingestion of vegetable proteins animal tissues are formed. Roughly 10 pounds of vegetable protein are required for the construction of 1 pound of animal protein. Through the ingestion of animal and vegetable proteins man is able to build his body structure. While protein as can be seen from its constituents serves as a source of energy its chief function is to supply the tissue building material.

Chemically protein is a complex organic substance containing carbon hydrogen nitrogen oxygen and sulfur. Some proteins also contain phosphorus and other elements. As indicated in

Chapter 2, during the process of digestion, protein is broken down into its structural units, the amino acids. These amino acids are carried in the blood stream to all parts of the body. The individual body cells are thus enabled to pick from this supply the particular amino acids necessary for growth, repair, formation of new tissue, including enzymes, hormones, hemoglobin, antibodies. The process may be likened to the building up of various words by selection and combinations of the individual letters of the alphabet. A molecule of protein may combine as many as several hundred individual amino acids. Countless combinations are possible. The amino acids not immediately utilized for structural purposes or to a slight extent stored as reserve protein are broken down and used as energy.

Certain of these amino acids must be supplied preformed to the body by way of the ingested food. The others can be synthesized one from another within the body itself. They are accordingly divided into two groups: **essential** (occasionally called indispensable) and **nonessential** (often referred to as dispensable). Obviously all amino acids (about 25 are known to exist) are essential, however, those differentiated as essential are unable to be synthesized by the body itself.

Table 8 lists the two major groups of amino acids. A few which are not considered of primary importance (1953) are not included.

TABLE 8

ESSENTIAL	NONESSENTIAL
(Arginine)	Alanine
(Histidine)	Aspartic acid
Isoleucine	Citrulline
Leucine	Cysteine
Lysine	Cystine
Methionine	Glutamic acid
Phenylalanine	Glycine
Threonine	Proline
Tryptophane	Hydroxyproline
Valine	Serine
	Tyrosine

Those in parentheses indicate that they are believed essential for growth but not for maintenance in the adult man.

We used to be concerned with the total protein intake, but now it is evident that it is the amino acids that are the essential nutrients, not the proteins alone.

Proteins may be classified according to their composition and physical characteristics

1 Simple proteins yield amino acids or their derivatives upon hydrolysis. Simple proteins may be subdivided into a number of groups but only two groups need mentioning here—the allumins to which belong egg albumin and serum albumin (blood), leucosin of wheat, legumelin of peas, and the globulins, examples of which include serum globulin, muscle globulin, edestin of wheat and legumin of beans and peas.

2 Conjugated proteins are substances which contain the protein molecule united to some other molecule. Examples are the nucleoproteins found in thymus gland and wheat germ which contain nucleic acid, the glycoproteins containing carbohydrate (the mucins), the phosphoproteins containing phosphorus—caseinogen (milk), ovovitellin (egg yolk) and the hemoglobins which contain hematin—for example, the hemoglobin of blood.

3 Derived proteins are products resulting from partial hydrolysis. They include proteans, metaproteins, coagulated proteins, proteoses, peptones and peptides.

Primarily, the protein needs and specifically the amino acid needs, have been measured in two ways—one by *animal experiments* which evaluated growth and two through studies which measured the nitrogen balance of subjects. Recent research has suggested the possibility of determining the amino acid content of the blood and urine.

As early as 1897 Rubner indicated that all proteins were not of equal value. The reason, as we now know, is the variation in amino acid content. However, Thomas B. Osborne, who was at the Connecticut Agricultural Experiment Station in New Haven, and Lafayette B. Mendel of Yale, through their painstaking well known experiments established the fact that "*certain amino acids cannot be synthesized by living cells out of materials ordinarily present and consequently must be supplied in a preformed state*." This information was published in 1914. The data were obtained from animal feeding experiments which were evaluated by the rate of growth of the animal.

For example, Osborne and Mendel showed that if rats were given casein (protein of milk) as the only protein in an otherwise adequate diet they grew satisfactorily. If the casein was replaced by gliadin (one of the proteins of wheat), the animals were able to maintain their weight but did not grow. When zein, one of the proteins of corn, replaced the casein, the animals

lost weight and died. Zein lacks the amino acids, lysine and tryptophane. Gliadin contains but small amounts of lysine.

Experiments continued through the years. W. C. Rose and his associates at Illinois announced that ten amino acids were found to be essential dietary components for the growing rat. Although arginine can be synthesized by the rat, this cannot be accomplished at a rate commensurate with the needs of the organism for maximum growth.

A second approach to protein metabolism in the body has been to measure the *nitrogen of the urine*. When the nitrogen eliminated is exactly equal to the nitrogen of the diet (protein is approximately 16% nitrogen), nitrogen equilibrium (or nitrogen balance) is said to exist. If outgo exceeds intake, a loss of body protein is indicated, and the balance is negative. Such a condition exists when the metabolism is elevated in fevers or toxic states. If intake exceeds outgo, there is storage of protein, and the balance is then positive. This occurs during periods of growth such as infancy, childhood, or adolescence, pregnancy or lactation, and recovery from a malnourished state or a healing process. The normal maintenance diet should be such that nitrogen equilibrium is possible. The protein level at which nitrogen equilibrium can be established is dependent upon the carbohydrate level of the diet and the total caloric intake.

W. C. Rose conducted a ten-year investigation, using male graduate students as subjects, to establish the amino acid requirements of *human subjects*. He found that there were eight amino acids essential to adult maintenance of nitrogen equilibrium. *These are the amino acids listed as essential in Table 8.* Arginine and histidine were found nonessential (although necessary for growth in the rat) and were therefore placed in parentheses.

Since Rose had established the qualitative amino acid requirements of man, he set out to determine the smallest amount of each of the eight essentials which would suffice to maintain nitrogen equilibrium. In 1949 Dr. Rose published the results of his five years' investigation as minimum requirements of essential amino acids. In addition, to provide for the chance that some individuals might require even more of the amino acids than those actually observed by Rose, he suggested "recommended

daily intake" which was twice the amount found as a requirement. These suggestions of Dr. Rose's are summarized in Table 9. These recommendations are based on the assumption that an adequate amount of additional protein will be ingested so that synthesis of nonessential amino acids will take place.

TABLE 9

ESSENTIAL AMINO ACID NEEDS OF MAN\*  
MINIMUM AND SAFE INTAKES FOR NORMAL MAN

WHEN THE DIET FURNISHES SUFFICIENT NITROGEN FOR THE SYNTHESIS  
OF THE NONESSENTIALS

AMINO ACID	MINIMUM DAILY REQUIREMENT (GM.)	SAFE DAILY INTAKE (GM.)	NUMBER OF SUBJECTS TESTED
L-Tryptophan	0.5	0.5	37
L-Phenylalanine	1.10	2.2	33
L-Lysine	0.80	1.6	33
L-Threonine	0.50	1.0	24
L-Valine	0.80	1.6	29
L-Methionine	1.10	2.2	19
L-Leucine	1.10	2.2	14
L-Isoleucine	0.70	1.4	14

\*Rose, W. C. *Clem. & Engineer News* 50: 3385, 1952.

Recently, Albanese reported on his experiments concerning the amino acid needs of male infants. He found that all ten of the so-called essential amino acids were necessary for growth in the human infant. In addition as a result of his investigations he suggested minimum and recommended amounts of each amino acid. He also revealed that evidence had been presented which supported the concept that certain amino acid deficiencies in man can be identified by changes in amino acid levels in the urine or the blood.

What then are the sources of these essential and nonessential amino acids? In order to clarify the differences between individual protein foods the following classification has sometimes been used:

1. Complete protein is one which will maintain life and support growth when used as the sole source of protein food. These foods are also spoken of as adequate Class A protein or a protein of high biological value. Animal proteins such as milk, eggs, cheese, meat, and fish have a high biological value. They are complete proteins and thereby contain all of the essential amino acids. Gelatin is the exception; it is not a complete protein for it lacks three essential amino acids—valine, tryptophan, and isoleucine.

2 "Partially incomplete protein" is one which maintains life but does not support normal growth. These proteins are often called inadequate, or a Class B protein. They contain many amino acids but not all of the essential ones. The cereal and vegetable proteins have a lower biological value, i.e., they lack some of the important amino acids and alone they cannot support growth, hence, they are called partially incomplete proteins. Vegetable proteins such as the legumes (beans, peas, lentils, and peanuts), are sometimes called "poor man's meat," because the protein of these foods can satisfactorily supplement the animal group. By the inclusion of these proteins in the diet, the animal proteins (always more costly in dollars and cents) may be decreased in amount.

3 "Incomplete proteins" are incapable either of maintaining life or of supporting growth when used as the only protein. The most striking examples of this group are zein of corn and gelatin.

These classifications are not inflexible, for a food may contain all of the essential amino acids and still have low biological value. If some of the essential acids are present in small amounts, obviously large quantities of the food must be consumed in order to assure adequacy. Such a food is excellent to supplement other proteins but not practicable as the only one. Soybeans belong to this class.

The value of supplementation has long been recognized. However, only recently has the importance of the time factor in ingesting amino acids been realized. *For protein synthesis, it has been found that all the essential components have to be present simultaneously.* As was indicated previously, amino acids that are not used for structural growth are irreversibly metabolized and are therefore not available for synthesis. It is known, for example, that the protein of milk supplements the protein of wheat, and to secure maximum effectiveness they must be taken together. Thus additional information on the amino acid content of food will result in the ability to supplement proteins, combine them, or enrich them in such a manner that the essential amino acid content is made adequate. This will bring about a lowering of the cost of protein food.

The thought behind the Cornell formula and possible lysine fortification is the inability of cereal products alone to be completely adequate for optimum growth due to the deficiency in certain amino acids. In wheat it is the amino acid lysine which is so limited in amount that the cereal protein can serve as complete protein only to the extent of 50%. Milk contains an abun-

dance of lysine. The right combination of milk and wheat results in enough lysine to make both proteins complete. Since enough milk to accomplish this is not feasible in bread the soybean and wheat germ are added. The wheat germ is a restoration of the milled flour to whole wheat status.

To those who eat but three or four slices a day the improvement in 'bread' is not significant. To those who are heavy bread eaters—eight to ten slices a day—especially when the budget necessarily restricts the animal proteins—this added enrichment is of definite economic value. If a better food can be obtained be equally palatable and at essentially no additional cost it seems sensible to get the most for the money spent.

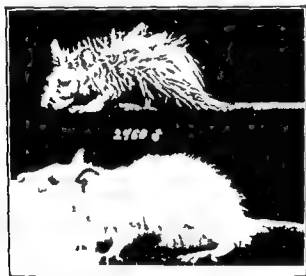


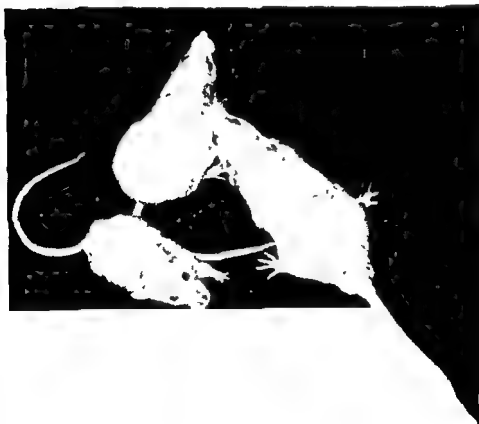
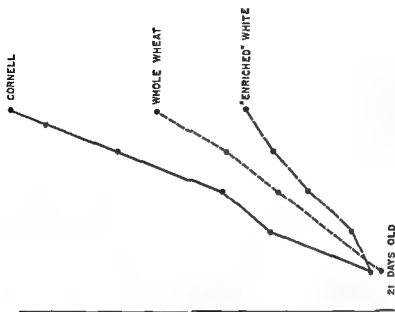
Fig. 11—The upper photograph shows the effect of a dietary deficiency of the amino acid valine. The lower photograph shows the same animal after valine had been administered for ten days. (From Rose and F. Patein, *J. Biol. Chem.* 159: 683, 1949.)

From this type of bread improvement it is possible to go on to the improvement of other cereal products and so reduce the cost but not the quality of our protein foods—or to make more good protein available.

Figs. 12 and 13 indicate the effect on growth of animals fed on only enriched white bread and the Cornell formula bread in the same quantitative amounts. The improvement is obvious.

The amino acid content of some food has been determined (See Table 10). Perhaps it soon will be possible to chart the





Figs 12 and 13.—Show the difference in growth response of rats fed enriched white bread, 100% whole wheat bread, and bread made from the Cornell formula. In size and appearance the whole wheat bread is between the 'Cornell' and the enriched white. The growth and appearance of the Cornell fed rat are essentially that of a control rat fed standard rat chow. The smallest rat not only is smaller but patches of hair loss can be noted on the back at the hind legs.



amino acids as we do the vitamins and minerals indicating need deficiency signs and sources

In the breakdown of protein in the body certain amino acids are found to be capable of yielding glucose (a simple sugar) and others of yielding a fatty acid. This fact is of importance in the diet planning for those conditions in which carbohydrate metabolism is impaired since this glucose is treated by the body in the same manner as ingested glucose. On the average 50% of the protein by weight may be considered to be potential sugar and 50% to be potential fatty acid (58% glucose and 46% fatty acid to be exact the total of 104% is due to the overlapping of certain amino acids). If adequate protein is not present in the diet one tissue may be called upon to supply repair material for a more important one. Such a shift takes place in starvation wasting diseases and sometimes when high fever is present.

It is possible to decrease protein oxidation for energy purposes by inclusion of an abundance of carbohydrate hence one speaks of the **sparing action of carbohydrate**. Protein is much more efficiently used in the presence of abundant carbohydrate than in the presence of abundant fat. Carbohydrate therefore is a more effective protein sparer than fat.

The protein requirement has been a controversial matter for some years. There have been those who advocated very low protein intake on the premise that large intake increases the work thrown on the kidneys (the excretion of urea and ammonia as well as the acids resulting from the mineral content of the protein). There have also been those who advocated high intake of protein. Today the consensus is that a middle course is preferable.

When protein supplies approximately 10% of the required calories the gram amount is essentially that recommended by the National Research Council for usual activities

$$10\% \text{ of } 3000 \text{ calories} = \frac{300 \text{ protein calories}}{4 \text{ calories/gm}} = 75 \text{ gm protein or } 1 \text{ gm/kg body weight}$$

Inasmuch as protein metabolism is not increased by activity when *excessively* hard work is carried on the protein is not equal to 10% of the calories

However, when the high caloric intake is due to metabolic activity as in the late teen age boy, it will be seen that 100 gm of protein again represents 10% of his caloric need

If the diet contains a full quart of milk, extra egg, meat, or cheese as is so frequently the case when the budget permits this expenditure, the percentage of protein calories rises to around 15%

When the protein allowances for children are calculated according to their greater need in relation to their size, it will be found that the protein level suggested as optimum is not far from 15% of their caloric need. The formula for the infant carries out this relationship (See discussion in Chapter 19)

Then, for a rough estimation of optimum protein intake the range of 10 to 15% may be used. It is an easily remembered range when exact figures are not available and when calculated back to the suggested intake on a basis of kilograms of body weight, it will be found to correlate satisfactorily

TABLE 11

RECOMMENDED DAILY DIETARY ALLOWANCES FOR PROTEIN  
Food and Nutrition Board National Research Council Revised 1953

	AGE (YR)	WEIGHT	HEIGHT	PROTEIN
		KG (LB)	CM (IN)	GM
Men	25	65 (143)	170 (67)	65
	45	65 (143)	170 (67)	65
	65	65 (143)	170 (67)	65
Women	25	55 (121)	157 (62)	55
	45	55 (121)	157 (62)	55
	65	55 (121)	157 (62)	55
	Pregnant (3rd trimester) Lactating (850 ml daily)			80 100
Infants	0 1/12*			
	1/12 3/12	6 (13)	60 (24)	kg × 3.5
	4/12 9/12	9 (20)	70 (28)	kg × 3.5
	10/12 1	10 (22)	75 (30)	kg × 3.5
Children	1 3	12 (27)	87 (34)	40
	4 6	18 (40)	109 (43)	50
	7 9	27 (59)	129 (51)	60
Boys	10 12	35 (78)	144 (57)	70
	13 15	49 (108)	163 (64)	85
	16 20	63 (139)	175 (69)	100
Girls	10 12	36 (79)	144 (57)	70
	13 15	49 (108)	160 (63)	80
	16 20	54 (120)	162 (64)	75

\*See Table 3 for explanatory footnote

Such percentage will supply about 3.5 gm. of protein per kilogram of body weight in the infant. During those early years, 3.5 gm. per kilogram is usually ingested; later as the first rapid growth diminishes (at 5 to 7 years), the protein may be dropped to 2 gm. per kilogram until after puberty. Throughout adult life the protein can be decreased to 1 gm. It should never be allowed to drop below this level unless therapeutically imperative. The recommendations of the National Research Council for protein intake for specific age groups are found in Table 11.

As indicated in Chapter 2, the body proteins are continuously undergoing synthesis and breakdown. They are not static tissues; *resynthesis occurs even in the starved animal.* This new idea is contrary to the older theory which postulates little or no change in the tissues once they are formed. The breakdown and rebuilding are normally in such balance that total body protein remains essentially unchanged. Experiments on rats indicate that half of the body proteins will undergo such change in a week's time.

With the higher levels of 1 gm. or more per kilogram, proteins of lower biological value may supplement the animal group. The general dietetic practice of obtaining half of the protein from animal and half from vegetable sources results in a satisfactory balance of amino acids and is both economical and palatable.

Since protein is approximately 16% nitrogen, the amount of protein metabolized can be calculated by multiplying the nitrogen in the urine by the factor 6.25 ( $100 \div 16\%$ ). In fact, the protein content of food is determined by multiplying the nitrogen value, as ascertained chemically, by this factor.

### Protein Foods

As has been pointed out, an adequate amount of protein is essential for normal growth and development, and approximately one-half of the protein must be of high biological value. Knowledge of the protein foods available is essential if one is to meet this requirement intelligently. While almost all foods contain some protein, foods are classed as protein foods only when the amount of protein is sufficient to be of definite value when the

ood is ingested in normal amounts. The chief sources of protein are milk, milk products, meat, fish, eggs, legumes, cereals, and some vegetables.

Milk, the first protein food which comes to mind, is of great importance throughout life. Its routine inclusion in the daily diet in keeping with the suggestions of the Basic Seven, 1 pint per day for adults to  $\frac{3}{4}$  or 1 quart per day for the growing child and 1 quart in pregnancy, is protection against deficiencies of protein, calcium, phosphorus, and vitamins A and B<sub>2</sub> (or riboflavin).

The composition of milk varies slightly with the breed of cow, season of the year, and feeding schedule, but the average composition is 86% water, 3.3% protein, 4% fat, 5% carbohydrate, and 0.7% minerals. Its caloric value is approximately 670 calories a quart. The specific nutritive value of a quart is indicated in Table 12.

TABLE 12

## NUTRITIVE VALUE OF 1 QUART OF MILK\*

Recommended Dietary Allowances (Revised, 1953) of 25 year old Reference Woman

ELEMENT	AMOUNT FOUND IN 1 QUART MILK	RECOMMENDED DIETARY ALLOWANCE OF 25 YEAR OLD REFERENCE WOMAN
Calories	666	2,300
Protein	34.2 gm	55 gm
Fat	38.1 gm	
Carbohydrate	47.8 gm	
Calcium	1.15 gm	0.8 gm
Phosphorus	908 mg	
Iron	0.7 mg	12 mg
Vitamin A	(1,550) International Units	5,000
Thiamine	0.35 mg	1.2 mg
Riboflavin	1.68 mg	1.4 mg
Niacin	1.1 mg	12 mg
Ascorbic acid	13 mg	70 mg
Vitamin D	(May be fortified)	
Also contains small amounts of		
Magnesium		
Potassium		
Sodium		
Chlorine		
Copper		
Manganese		

\*From U. S. Department of Agriculture Handbook No. 8 Composition of Foods Raw Processed Prepared

The proteins of milk are three casein (27%) lactalbumin and lactoglobulin (the latter two together form 05% see Proteins classification) The carbohydrate is in the form of lactose (milk sugar) The fat is a mixture of the glycerides of palmitic oleic myristic and butyric acids The first two glycerides occur in greatest amounts The fat is emulsified in the form of very fine droplets which increase the ease of its digestion The important minerals of milk are calcium phosphorus and potassium and riboflavin is one of its important contributions The major deficiency of milk is its low iron content The iron present is however in readily available form The lack of iron is compensated for in early life by the extra iron stores in the liver of the newborn infant

As the result of pasteurization the vitamin C (ascorbic acid) content of milk is lowered to around 1 mg per 100 gm or roughly to one half that of the raw milk Fortunately it is not necessary to depend on milk as a source of vitamin C

Since milk forms such an important item in the diet and since it provides an excellent medium for the rapid multiplication of harmful bacteria (see discussion of undulant fever) it is marketed under strict *sanitary control and inspection* It is graded according to bacteriological standards into certified grade A and grade B Fluid milk may be sold in many forms: certified raw or pasteurized pasteurized whole milk homogenized and fortified milk Other fluid milks which have been modified to some extent are skim milk buttermilk various commercial milks and yogurt In addition there are many milk products such as evaporated milk powdered milk and cheeses

*Certified* milk may be sold in the raw state other grades of milk must be pasteurized Its certification means that the conditions under which it was produced and distributed conform with the high standards for cleanliness set forth by the American Association of Medical Milk Commissions The State Board of Health supervises the production and distribution of certified milk as well as that of other milks As indicated certified milk may be sold either raw or pasteurized The possibility exists however that between periods of inspection infection may develop in a herd

By *pasteurization* is meant the heating of milk to destroy disease producing organisms and usually 99% of all the bacteria

which may be found in milk. Two methods are used. In the first, the milk is heated to at least  $143^{\circ}\text{F}$  and held at that temperature for not less than 30 minutes. This is the usual method and is often referred to as the "hold" method. The second way, milk is heated to at least  $160^{\circ}\text{F}$  for not less than 15 seconds and then it is promptly cooled to  $50^{\circ}\text{F}$  or lower. This is done in approved and properly operated equipment. By pasteurization, the milk is not only made safe, but its keeping quality is improved. The food value is not changed significantly, although, as indicated previously, some thiamine and ascorbic acid are lost.

Pasteurized milk is usually sold as whole milk, however, many prefer homogenized and irradiated or fortified milk. *Homogenized milk* is whole milk which has been forced under high pressure through fine apertures with a resulting decrease in the size of the fat globules. This marked decrease in the fat droplet size alters the quality of the milk. No longer will the cream rise to the surface when the milk is allowed to stand, the mixture is homogeneous throughout. The curd size is smaller and somewhat more easily digested. There is a slight alteration in flavor. The food value of milk is unchanged by the homogenization process.

*Fortified milks* are those containing added amounts of one or more of the essential nutrients normally present in milk. The Council on Foods and Nutrition of the American Medical Association recognized the fortification of whole milk with vitamin D a fact of public health significance. Vitamin D milk must contain 400 USP units of vitamin D per quart to meet the requirements for acceptance by the Council. This is usually added in the form of a concentrate.

*Other milks* which are sold widely are modified to some extent. This is especially true of skim milk. Skimmed milk may be defined as milk from which a sufficient proportion of fat has been removed to reduce its milk fat content to less than 3.25%. Usually, however, the available fat in skim milk is less than 0.1%. Nonfat milk solids, from 0.5 to 1.5%, have been added to some skim milks. By removing the fat from milk, the vitamin A content is also removed. Other nutrients remain essentially unchanged and, when nonfat dry milk solids are added, the values are enhanced. Occasionally skim milk is fortified with a vitamin



A and a vitamin D concentrate, this usually contains 2,000 International Units of vitamin A and 400 U S P units of vitamin D per quart

*Buttermilk* is usually the by product of the churning of sour cream into butter. There is also sweet cream buttermilk which is, in turn, the by product of the churning of sweet cream in the preparation of sweet cream butter. Buttermilk may also be cultured. This is usually accomplished by the addition of the bacteria *Streptococcus lactis* to either skim or whole milk until the acidity is 0.8 to 0.9%. The butter fat content of these milks ranges from 0.1 to 1.5%.

Various commercial milk products are available, protein milk, lactic acid milk, hypoallergic milks low sodium, and others. These have their places in therapeutic diets, but space does not permit a discussion of them here.

Excess fluid milk, or milk produced in sections well adapted to dairying, but far removed from immediate consumers, is preserved for future use by evaporation into three different products. *Evaporated milk* is milk concentrated to approximately one half its original volume. No sugar is added, but it is subjected to much drastic heat treatment (more so than condensed milk). The water is removed by heating the milk at 120° to 140° F. in vacuum pans. After evaporation, the milk is homogenized, cooled, placed in cans and sterilized (240° F. for 15 minutes). Now most of the evaporated milk is fortified with vitamin D.

*Condensed milk* has sugar added to it in the amount of 1 pound to 100 pounds of milk before the process of evaporation is begun. The finished product contains about 5.4% sucrose. The sugar acts as a preservative so the milk, when it has been sealed in cans, can be stored without further heat treatment.

Several processes have been invented for the reduction of milk to powdered form. *Dried milk* is made from whole milk and nonfat dry milk solids are made from skim milk. The milk is preheated at 140 to 180° F. for 20 to 30 minutes and then it is concentrated in vacuum pans. The milk is dried by spraying it into a chamber of hot air or onto a slowly revolving heated drum under vacuum. From 95 to 98% of the water is removed in this process. Nonfat dry milk solids may be stored for long periods of time in moisture proof bags, drums, or cans at ordinary room temperatures. Dried whole milk is usually packed

aged in vacuum cans and can be stored at room temperature until opened. After opening they must be refrigerated as the fat may become rancid.

As a result of these processes the composition of milk becomes

	% P	% F	% C	% Ash	% H <sub>2</sub> O
Evaporated	9.6	9.3	11.2	1.7	68.2
Condensed (sweetened)	8.8	8.3	51.1	1.9	26.9
Powdered or dried	26.7	28.0	38.0	5.8	1.1

TABLE 13

COMPARATIVE COST FOR 1 OUNCE (30 GM.) PROTEIN  
(Prices of August, 1954)

FOOD	AMOUNT CONTAINING 30 GM. PROTEIN	COST
Steak (round)	4 oz	19¢
Lamb chop (rib with bone)	8 oz	43¢
Beef stew meat (chuck)	4 oz	14¢
Beef liver	4 oz	6½¢
Fish (haddock)	5¼ oz	21¢
Cheddar cheese	4 oz	18¢
Egg (medium)	5 (each)	37½¢
Whole milk (homogenized)	26 fl oz	91¢
Skim milk	25 fl oz	16¢
Nonfat dry milk solids	11 T	6¢
Bread (white)	12 oz	10¢
	(approximately)	
Oatmeal (dry)	¾ cup	20¢

Milk is an economical food at any unit cost that may prevail. Table 13 illustrates this economy by a comparison of the cost of 1 oz (30 gm.) of protein from several sources. No other single food contributes so much in nutriment. Table 12 indicates its nutritive value.

In the book *Your Meals and Your Money* Gove Hambidge writes: "Perhaps no single thing would bring about a greater improvement in the American dietary as a whole than a liberal use of milk and milk products."

Where whole milk seems costly, nonfat dry milk solids and evaporated milk can make satisfactory substitutes. When skim milk is used, the decrease in calories due to fat subtraction and the loss of the fat-soluble vitamin A must be considered.

Cheese is the clotted portion of milk and has therefore a high protein content. Left behind after the removal of the curd is a milky liquid known as whey. This has the composition: water 83%, protein 1%, fat 0.3%, carbohydrate 0.5%, and min

erals 0.7%. It contains lactalbumin, soluble salts, water soluble vitamins, and sugar. Cheese is of two main classes, hard and soft. The manufacture of cheese was probably originally a means of preservation of milk, but today cheese forms an important part of the diet. It ranks first from the standpoint of amount of protein. No other food contains more per unit of weight. For example, an American cheese (hard) gave an analysis of water 27%, protein 28%, carbohydrate 4%, and minerals 4%. Meats and fish vary from 13 to 25% protein, beans 22%, cereals 8 to 12%, and fruits and vegetables 1 to 3%. One pound of cheese is equivalent to approximately 1 gallon of milk in protein value. Cheese is marketed as skim milk cheese, cream cheese or full cream cheese, depending upon the fat content.

**Eggs** Milk and eggs are sometimes spoken of as perfect foods because they alone adequately support growth or development of the young. Egg contains approximately 74% water, 14.5% protein, 10.5% fat, and 1% minerals. The white contains albumin, globulin, glycoproteins, and ovalbumin. The yolk contains albumin, nuclealbumin as vitellin and lecithin, phosphorus, calcium, sulfur, potassium, and iron. The fat is admixed with the protein in the egg yolk to form an emulsion (see Chapter 4). Egg yolk is also a carrier of vitamins A, thiamine, riboflavin, and D. The Basic Seven recommends one egg a day, and at least four a week.

### Meat

All meat has essentially the same physical structure, nutritive value, and digestibility. As the term is usually used, it includes poultry and fish.

Meat or muscle tissue is composed of bundles of tiny fibers embedded in and held together by white fibrous connective tissue. The length of these bundles and the extent of the connective tissue largely determine the tenderness of the meat. In the young animal with unused muscles, the fibers and connective tissue are tender, but as he grows older and exercises more, they become increasingly tougher. Imbedded with the fibers of the connective tissue is a fat characteristic of the animal. This varies in amount, but even the leanest meat has some fat.

Meat is 13 to 25% protein, uncooked weight (25 to 30% after cooking), 10 to 15% fat, 50 to 60% water, and 1% ash. Meat

is an excellent source of the B vitamins, including niacin which is present only in traces in dairy products and eggs, and of phosphorus, potassium, and sulfur. Its caloric value varies with the fat content from 25 to 100 calories per ounce, averaging 60 calories.

Meats owe their flavors largely to the extractives which are present. These extractives have a stimulating effect on the flow of gastric juice. Meats are almost completely digested with ease (96 to 98%). Contrary to the often expressed theory, this does not mean that meat is a constipating food, even though it leaves little residue.

The idea that a difference exists between light and dark meats, or light meats and red meats is also prevalent. Dark meats do have slightly longer fibers and red meats a higher extractive content, but, in general, the *digestibility and composition are sufficiently equal to make discrimination unnecessary*.

The edible glandular meats fortunately are now coming into common usage. Our early ancestors considered the entrails of animals a luxury. Uncivilized tribes still do. As a result they have at hand means of preventing dietary errors. The edible glandular meats, liver, kidney and heart, are excellent foods as current research indicates.

Liver comes nearer to being a "panacea" for all ills than any other food. It is a protein of the highest order, contains rich stores of vitamin A and all of the members of the B group of vitamins. In addition, it is the greatest of all stimulators in the formation of red blood cells. Liver is an excellent source of iron and copper, but the power that it exerts in blood formation is out of proportion to this mineral content. Liver should be served once a week, and more often if desired.

Fish are commonly considered in two groups—those having a backbone (the vertebrates) and the shell fish. They may be further classified as fresh and salt water fish, lean or light fish and oily or dark fish. Salt water fish have the advantage of having a higher mineral content—this is of value as it pertains to fluorine and iodine. The dark or oily fish have a much higher fat content than the lean, a fact that may necessitate choice between them for therapeutic reasons. The nutritive value of fish as a meat alternative is often overlooked. Numerous feeding studies with laboratory animals have demonstrated that the

TABLE 14  
COMPARATIVE AMOUNT OF PROTEIN IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBO- HYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Whole milk	3.5	3.9	4.9	0.7	87.0	68
Skim milk	3.5	0.1	5.1	0.8	90.5	36
Nonfat dry milk solids	35.6	1.0	52.0	7.9	3.5	362
Whole egg (raw)	12.8	11.5	0.7	1.0	74.0	162
Egg white	10.8	0.0	0.8	0.6	87.8	50
Cottage cheese (skim milk)	19.5	0.5	2.0	1.5	76.5	95
Cheddar cheese	25.0	32.2	2.1	3.7	37.0	398
Lamb chop (rib, cooked)	24.0	35.0	0.0	1.2	40.0	418
Pork chop (loin, cooked)	23.0	26.0	0	1.2	50.0	333
Beef steak (sirloin, cooked)	23.0	22.0	0	1.1	54.0	297
Mackerel (raw)	18.7	12.0	0	1.2	68.1	188
Liver (beef, cooked)	23.6	7.7	9.7	1.8	57.2	208
Tongue (beef)	16.4	15.0	0.4	9.0	68.0	207

Adapted from U. S. Department of Agriculture Handbook No. 8 Composition of Foods Raw Processed Prepared

nutritional value of fish products is equal, and sometimes superior, to that of beef, the meat used for comparison. Research has indicated that the proteins from fish contain the essential amino acids in proportion to permit economical utilization of the protein. Besides being a "tasty" food, fish often costs substantially less than meat. So, from both a nutritional and a budgetary standpoint, fish is an excellent source of protein.

While legumes (beans, peas, lentils and peanuts) are classified as vegetables, they supply protein which has considerable value when supplemented by a small amount of animal protein. Lima beans have a protein value of 8%, soybeans, 13%, and peanuts and peanut butter, 26%.

Nuts are usually listed as fatty foods due to their high fat content but their protein content is likewise high, from 15 to 30%.

Cereals have a protein value of roughly 10%.

These proteins certainly should not be neglected when the high cost makes meat difficult to obtain in adequate amounts.

One of the objections to the use of dairy products and eggs as the exclusive source of animal protein is their low content of niacin, one of the B vitamins necessary for the prevention of pellagra (See Chapter 12) As has been pointed out, reliance on an egg and a pint of milk as the source of animal protein will yield only about 1 mg of niacin, whereas a serving of steak would yield 6 mg a serving of liver 16 mg, and a table spoon of peanut butter 16 mg, essentially the day's recommended allowance All of this emphasizes the need for variety in the diet if adequacy is to be obtained

Cooking of meats serves a threefold purpose First like other foods, cooking improves the palatability of meats by making them more attractive and more flavorful Second in many instances cooking renders meat tender and more digestible And third, in the case of pork products cooking serves as a health measure as it destroys the harmful organism the parasite *Trichinella spiralis* Any meat including those popularly considered "indigestible" are entirely suitable for general use Today it is believed that long cooking at lower temperature results in a more satisfactory product Thus a difference in tenderness is more a matter of cooking than the animal host

It is necessary to process animal foods to facilitate transportation and storage The methods most frequently used are heating, freezing drying and canning As each process modifies the character of the fresh material some loss in nutritive value may result

In quick freezing and subsequent low temperature storage, foods can be kept safely in a state approximating fresh food for longer periods of time if protected against oxidation Frozen foods seem to retain their nutritive value

Howe in writing of specific cases of the effect of food processing of protein foods upon the nutritive value, remarked "There is considerable evidence that the ordinary processes of cooking and processing of foods for human consumption do not seriously affect the nutritive value of the proteins in the amounts used in the average mixed diet" However he went on to state that there were considerable losses in the vitamin content of processed animal foods in home preparation and processing and in sub-

quent storage. This seems to occur when foods are processed, such as dried, then stored, prepared for serving, and then, perhaps, kept warm for serving.

A committee of the Food and Nutrition Board of the National Research Council prepared a report on the literature to date (1950) which was related to the problem of heat injury to dietary protein. From the information available, there seemed to be little injury by the methods now in use to the important protein foods, meat, and milk. The data showed, however, that there seems to be a marked deterioration of the protein value of the ready-to eat breakfast cereals. This was believed due to the current methods of processing. An important relationship in supplementation exists, however, as these breakfast cereals are usually eaten in combination with milk. Research has indicated that these processing methods render some of the amino acids unavailable for absorption.

### Review Questions

- 1 What are the structural units of proteins?
- 2 Distinguish between complete, partially incomplete, and incomplete proteins.
- 3 What are the principal food sources of the complete proteins?
- 4 What function may the incomplete proteins fill in the dietary? Name sources of these.
- 5 How does the chemical structure of protein differ from carbohydrate and fat?
- 6 What purposes do proteins serve? What is their most economical use?
- 7 How may the protein metabolism of the body be measured?
- 8 What is considered a satisfactory amount of protein to include in the daily dietary of adults for optimum nutrition?
- 9 Why is milk considered such an important protein food?
- 10 In what forms is milk sold?
- 11 What are other sources of protein?

### Suggested Projects

- 1 What is your recommended allowance of protein? From your menus (your diet record of the week), use the tables of food composition in the Appendix to calculate your average daily intake of protein. Is it too high? Too low? Why? What can you do to alter your diet pattern so that you will meet your recommended allowance?
- 2 From your menus list the protein foods you included. Classify them according to the two major groups described in this chapter. Determine the percentage each group contributed to your total carbohydrate intake.

- 3 What are the ten cheapest sources of protein on the market now?
- 4 What are the ten most expensive sources of protein on the market now?
- 5 Plan a low cost diet for one day that will furnish 60 to 70 gm of protein
- 6 Plan a day's diet for a vegetarian which excludes meat and eggs and which furnishes 60 to 70 gm of protein
- 7 Plan a day's diet to meet the protein needs of a girl between 16 and 20 without including milk in the menu. Would such a diet be adequate? Check it after the discussion of vitamins and minerals



## CHAPTER 6

### THE FATE OF FOODSTUFFS INGESTION, DIGESTION, ABSORPTION, UTILIZATION

The reduction of food for absorption and its subsequent utilization within the human organism progresses in an intricate step by step pattern. Recent research has indicated the interrelationship of certain vitamins and minerals in these reactions. It is possible that future studies will disclose even greater participation on the part of other nutrients. The psychic, motor, thermal, and chemical factors have been shown to strongly influence both the rate of digestion and the coefficient of digestibility.

As indicated in Chapter 2, there are four major steps to the metabolism of carbohydrates, fats, and proteins in the living organism. They are ingestion, the taking of food into the body, digestion, the preparation of food for cell use, absorption, the process whereby the breakdown products pass through the wall of the gastrointestinal tract, and utilization, the ways in which these constituents are carried by the blood to all cells of the body and are utilized as needed. Each successive process is dependent on the action of the preceding operation.

**Ingestion**, the eating of food, is usually a voluntary action. Occasionally, one will find a patient who cannot eat or a child who is coerced into eating his meals, but, for the most part, an individual controls his food intake. Many factors govern the food that we eat. Many of these, such as likes and dislikes, education, custom and culture patterns, economic conditions, were discussed in Chapter 1. However, within the framework of these social and emotional influences, the primary factors controlling ingestion are hunger and appetite. These two, hunger and appetite are so closely related that they are likely to become confused, and in the popular thinking, they are usually considered synonymous.

*Hunger* has been described as a basic drive resulting from actual contractions of the stomach. It is not believed to be influenced by previous experiences and can often be painful, as

demonstrated by the loud cries of a hungry infant. The pangs of hunger are not continuous in an empty stomach. They are usually not noticed if the individual eats three regular meals a day. Hunger may be inhibited by strong emotions and anger while outdoor exercise and physical activity in general may increase hunger.

*Appetite* on the other hand has been defined by Newburgh as a sensation produced by happy memories. It is believed that appetite may be acquired and its existence depends upon previous experiences with taste, smell of food, and is actually an expression of the anticipation of the pleasure associated with food. The differentiation is clear when it is noted that hunger may be sated by the eating of a meal while appetite encourages the additional intake of a favorite dessert. Recent investigations with mice primarily have indicated that there may be a physiological mechanism which governs the appetite. Thus both appetite and hunger are important influences in the first step, ingestion of food, of the vital process nourishing the body.

The reliability of these two mechanisms as a guide in choosing the necessary foods for proper nutrition has been studied upon several occasions. Most investigators have found that when simple nourishing foods have been presented children will in the long run choose foods that will provide the necessary nutrients. However, there are studies which indicate that a choice does not necessarily reflect what is good but rather what is liked. So the generally accepted belief seems to be that until more studies provide more conclusive evidence neither appetite nor hunger can be depended on to guide the individual in the proper selection of the nutrients necessary for health.

**Digestion** is considered to be that process whereby the food stuffs are changed into forms suitable for absorption and eventual body use. This process takes place within the gastrointestinal tract of the body. Fig. 14 illustrates the site of the important digestive organs of the alimentary canal (gastrointestinal tract). The first accurate knowledge of the activity of the gastrointestinal tract came about in 1822. Alexis St. Martin, a hunter, suffered a gunshot wound in the abdomen. Through the opening Beaumont observed the digestive reactions that took place and

described his observations in detail. St. Martin, who died at 83, had the abdominal opening throughout his life. Although some of the digestive fluids (which will be discussed presently) are

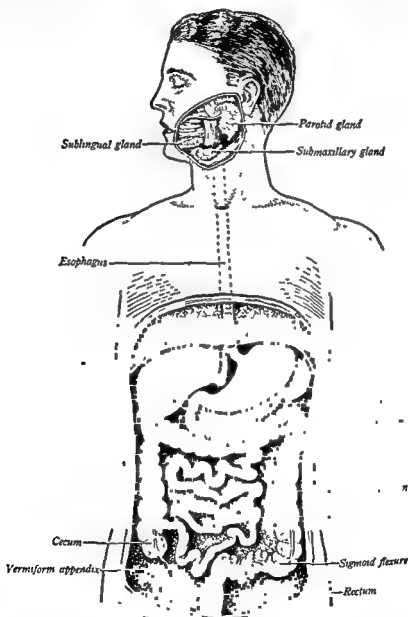


Fig 14 —Alimentary canal with digestive glands (From Kirkpatrick and Huettner Fundamentals of Health, Ginn and Co)

secreted from other sources, the gastrointestinal tract, along which digestion takes place, includes the following: the mouth, the stomach the small intestine, and, perhaps, the large intestine.

There are several factors involved in digestion (1) mechanical such as chewing and the motions of the gastrointestinal tract (2) chemical such as the pH of the alimentary canal and the activity of the enzymes and various secretions, and (3) regulatory factors as demonstrated by the flow of specific hormones and several inorganic materials. As the process of digestion is discussed each of these factors will be pointed out in relation to the specific reaction taking place. However it is important to note that all are necessary. In the process of digestion the mechanical, chemical and regulatory factors are all interrelated and dependent upon one another.

The digestive process is essentially hydrolytic. The active agents which bring about these changes are known as enzymes. These enzymes are specific in action yet within certain acidity (pH) ranges and in many instances are descriptively named. An enzyme may be defined as an organic substance which is produced by the living cells and has the ability when mixed with other organic material to bring about certain chemical changes without entering into the reaction itself. In other words an enzyme can be classed as a catalyst.

Some enzymes are known by their early names, however recently a newer nomenclature which follows the suggestion of Duclaux is universally used. Each hydrolytic enzyme is designated by the addition of the suffix *-ase* to the kind of substance it acts upon. For example an amylase is a starch splitting enzyme, a lipase a fat splitting enzyme and a protease a protein splitting enzyme. In addition the enzyme can be further identified by indicating the source of its secretion. One may speak of a pancreatic lipase or a gastric lipase. For simplification the substance upon which the enzymes act is referred to as the 'substrate'. Thus starch is the substrate of the pancreatic amylase and so on.

Recently some enzymes have been recognized to exist in the inactive form in the cells. The enzyme in an inactive state is called a *zymogen* and the characteristic ending is added to the name of the specific enzyme to indicate that it is in an inactive state. For example trypsinogen is a zymogen or specifically is the enzyme trypsin in an inactive state.

Enzymes those that we know to exist as zymogens as well as all others about which this point is not clear have to be activated.

in order to participate in digestion. Many substances may activate enzymes or serve as stimuli. These may be hormones, other enzymes, inorganic salts, or mechanical, psychic, chemical, or thermal stimuli. Each of these will be indicated as the specific role is discussed. Each enzyme has its specific activator or a combination of two or three of the substances which have been identified as possible activators.

As mentioned in previous chapters, cooking primarily serves to improve the palatability of foods, however, in some cases, preparation aids in digestion. This is true with starches, as illustrated in Chapter 3, when the membranes are dissolved by moist heat, thus making the swollen starch granules available to the digestive enzymes. Proper frying of foods increases the ability of the digestive enzymes to cope with the large quantities of fat ingested. Seldom does cooking improve the nutritive value of foods. An outstanding example of such improvement is the proper preparation of soybeans and egg white.

The mouth is the first site of digestion. Through the act of mastication, food is broken down into small particles, well moistened with saliva and is prepared for the action of the digestive enzymes.

Saliva is the first secretion of the gastrointestinal or digestive tract. It is poured into the mouth from several glands.

Saliva contains one principal enzyme and perhaps several others. Ptyalin or salivary diastase is the primary enzyme, whereas some literature indicates the presence of maltase, lactase, lipase, urease, and protease. Ptyalin acts upon the starches, provided they have been properly cooked, and changes them to maltose. While cooking has no digestive action upon starch, it does render it more available to digestive enzymes by rupturing the starch granules (see illustration under discussion of carbohydrates). Ptyalin has little effect upon raw starch. The sweetish taste which develops when a bit of cooked starch is held in the mouth is evidence of the change from starch to dextrins (intermediary products in the breakdown to maltose), as the result of enzymatic action.

The discharge of saliva (there may be 1,000 to 1,500 c c daily) is under psychic control. Even the sight or thought of palatable food, especially when hunger is present, normally results in the "mouth watering." Animal experiments indicate that as the

mouth waters, or saliva gathers in expectation of work to do, so are the digestive juices in other regions of the digestive tract summoned for action. The actual tasting of palatable food intensifies this effect. The end result is optimum digestion. This is an important factor in meal planning. Pleasant anticipation of meals and enjoyment during mealtime are also important factors. It can be further demonstrated that anger, fear, or extreme fatigue are factors in retarding the secretion of digestive juices and normal digestive activity. Chlorine and bromine have also been shown to be activators of the secretion of saliva. The pH of the mouth varies from 6.4 to 7.3. However, ptyalin can react over a range of pH 4 to 9.

Saliva also contains traces of maltase which may convert some maltose to glucose.

The action of saliva begun in the mouth is continued in the stomach until such time as the acidity of the gastric juice permeates the food mass and stops salivary action. Saliva is not far from neutral in reaction and its activity is inhibited by highly acidic or basic conditions.

From the mouth food passes down through the esophagus or gullet to the stomach in approximately five seconds by means of wavelike propulsive motion known as peristalsis. A contracted band at the end of the esophagus, called the cardia or cardiac sphincter, guards the entrance into the stomach. This sphincter is relaxed by the oncoming wave. The stomach is not of definite size, but is an elastic organ adjustable to the volume of its contents.

Contrary to popular belief the stomach is less a digestive organ than a reservoir. It is true that important protein digestion takes place there but its more important job is that of slowly admitting food into the small intestine where the major act of digestion is carried on.

It is said that the gastric juice appears on the lining of the stomach as profuse perspiration appears on the skin. It is secreted in the fundic end of the stomach (the upper or cardiac end) as a clear, water fluid in amounts of two to three liters daily.

The production of gastric juice as well as other digestive juices, is subject to hormonal control. A hormone may be defined as a substance which cells in one part of the body produce

and pour into the blood stream for action elsewhere. The first of these hormones of the digestive tract, in order from above down, is gastrin. Gastrin, as its name implies, acts in the stomach. It is formed in the lower part of the stomach and the upper part of the small intestine in response to the mechanical pressure of food. It is absorbed into the general circulation and goes to all tissues of the body. Only one section responds, however, the lining of the stomach where the stimulus originated. The stomach continues to secrete gastric juice as long as food is in the stomach. When food is no longer present, gastrin ceases to be produced. As a result of this hormonal control the secreting cells have periods of rest.

The gastric juice contains 0.2 to 0.4% hydrochloric acid and is therefore, strongly acidic. Abnormally high acidity is known as hyperacidity, or hyperchlorhydria, and abnormally low acid content is known as hypoacidity, or hypochlorhydria. Achlorhydria refers to the absence of hydrochloric acid. One of the primary purposes of the hydrochloric acid content of the gastric juice is to provide the proper pH for the action of the enzymes. Other functions of hydrochloric acid are to act as an antiseptic in inhibiting the growth or destroying certain harmful bacteria, and it is possible that it might exert a slight hydrolytic action on the disaccharides.

Pepsin is the most important constituent of the gastric juice. It exists in the inactive form as pepsinogen but, in the presence of hydrochloric acid, pepsinogen is converted to pepsin. It acts upon proteins and reduces them to cleavage products known as proteoses and peptones (see classification of protein, Chapter 5). These cleavage products are later reduced to amino acids in the small intestine.

It was formerly thought that the gastric juice also contained rennin. It is now believed that rennin occurs in the fourth stomach of the young calf and in other animals, but not in either the infant or adult human being. It was thought that rennin was necessary to curdle milk, however, recent research indicates that casein is precipitated by both pepsin and hydrochloric acid. The commercial rennins such as Junket, which also curdle milk are prepared from the lining of the calf's stomach.

Gastric lipase which acts on the fats, is the fourth digestive ingredient. The value and extent of the juice is a somewhat con-

controversial matter. The optimum pH for its activity is about 7.8 and the pH of the stomach is far below its range. Because of the highly acid condition it is doubtful if unemulsified fats are emulsified in the stomach. However, it has been suggested that if any activity occurs on the part of the gastric lipase it is to perform on the preformed emulsions such as milk cream and egg yolk.

In the stomach absorption of water, salts, sugar, alcohol and certain drugs may take place, but absorption is really a function of the small intestine.

Mechanical pressure is exerted by stomach muscles on the food while it is in the stomach, but the food is not churned and mixed in the manner of popular thought. These movements take place in orderly fashion. The fundic end of the stomach acts as a storehouse for food which in the pyloric end of the stomach is subjected to active digestion. At the pyloric or antrum end of the stomach the food is thoroughly mixed with gastric juice and is broken up by this process and by the mechanical action of the stomach musculature. When this action is complete and the stomach contents are well acidified, relaxation of the sphincter guarding the stomach-intestinal junction (the pylorus) takes place. This opening of the pylorus is activated by the consistency of the food mass, by the tension of the stomach muscles, by fullness or emptiness of the duodenum and by peristaltic waves within the stomach. As the fluid or semifluid mixture of food material known as chyme passes down through the pyloric sphincter, the upper portion of the stomach slowly contracts upon the food mass held there and forces it down into the lower portion where more active digestion takes place.

*The length of time food remains in the stomach is dependent upon several factors.* The stomach may be emptied in one hour or emptying may require six or seven hours. A carbohydrate meal leaves the stomach more rapidly than does a protein meal which in turn leaves the stomach more quickly than a meal of fat. A combination of protein and fat remains in the stomach the longest. This accounts for the "stick to the ribs" or satiety value of protein and fat foods. If in quantity, it depresses the flow of gastric juice and slows up the emptying time. The aver-



age time required for the stomach to discharge an ordinary meal is three to five hours. *Psychic factors, however, may interfere with this time*

The third section of the digestive tract is the intestines, which are divided structurally, into two main parts, the small and the large intestine, the latter being also called the colon. The first ten inches of the small intestine adjacent to the stomach, is known as the duodenum, the next eight feet as the jejunum, and the remainder as the ileum. There is no marked difference in these sections. At the junction of the small intestine and the large intestine is the ileocecal valve or sphincter, and a small pouch called the cecum, at which point is situated the vermiform appendix. The ileocecal sphincter prevents too rapid passage of material from the small intestine into the large intestine, and also prevents the back passage of fecal matter. Passage of material through this valve is sometimes spoken of as internal defecation.

As can be seen from Fig. 14, the colon may be considered as sectional—ascending, transverse and descending colon, the S shaped curve known as the sigmoid, and finally the straight strip, the rectum which ends in the anal sphincter, the anus.

The small intestine is about one inch in diameter and about twenty feet in length. The large intestine is about two inches in diameter and five feet in length.

Digestion is most active in the small intestine. Here, again hormonal, chemical, and mechanical factors work together. Under the influence of the acid food mass upon the mucous membrane of the duodenum a hormone known as secretin is produced which reaches the pancreas by way of the blood and stimulates it to secrete pancreatic juice.

In the same region of the intestinal wall from which secretion arises two other hormones are produced. One, enterogastrone, inhibits the motions of the stomach, it prevents the stomach from emptying a fatty meal too quickly—before the intestine is ready to receive it. This is a hormone with an inhibiting rather than a stimulating effect. Inhibiting hormones are known as chalones.

Another hormone cholecystokinin is produced when fatty food comes in contact with the intestinal wall, and stimulates the gall bladder to discharge its bile.

Pancreatic juice, bile and intestinal juice are poured almost simultaneously into the duodenum about three to four inches

below the stomach small intestine junction (or pyloric sphincter) These juices mutually interact upon each other and upon the incoming food

At the present time it is believed that the pancreatic juice contains six enzymes with the possibility of two more (1) *Pancreatic diastase* which is similar in action to ptyalin of the saliva It is also known as *amyllopsin* or *amylase* It is capable of splitting starch to maltose Even uncooked starch can be hydrolyzed to a slight extent by this enzyme However uncooked starch is only slowly acted upon and when large amounts are included in the diet the major portion will appear unchanged in the stool Bromine and chlorine are believed to activate the secretion of amyllopsin (2) *Lipase* or *steapsin*, whose work is the break down of the emulsified fats into fatty acids and glycerin (glycerol) (3) *Trypsin* the protein splitting enzyme or more correctly the inactive form of trypsin—its precursor trypsinogen This enzyme as it appears first in the pancreatic juice has no digestive power It becomes activated by an admixture with the activator the enterokinase of the intestinal juice and is thereby rendered capable of partially breaking down the protein molecule Unlike pepsin it does not require hydrochloric acid for its action (4) *Chymotrypsin* appears in the inactive form chymotrypsinogen and its activator is trypsin Its specific function is to bring about the further breakdown of the protein products of peptic and tryptic action The optimum pH for both trypsin and chymotrypsin is near 8 to 9 (5) The third proteolytic enzyme is *carboxypeptidase* This enzyme attacks peptides (the near complete breakdown of proteins) containing a free carboxyl group Thus free amino acids are split off This is part of the enzyme which was formerly called erepsin (6) *Nucleases* form part of the pancreatic juice Their function is to split the various nucleic acids such as yeast nucleic acid and thymus nucleic acid into component mononucleotides There is some indication that the pancreatic juice may contain two other enzymes lactase and sucrase

The extreme activity of enzymes is demonstrated by a study at Columbia and quoted by Dr Sherman in *The Science of Nutrition* In 30 minutes at body temperature pancreatic amylase digested roughly 20 000 times its weight in starch and about 10 000 times its weight in maltose

of time, it digested 4 000,000 times its weight in starch and 2 800,000 times its weight in maltose before becoming completely inactivated. This activity was at a dilution of 1 to 100,000,000 parts of water. This enzyme and others have been prepared in crystalline form and are proteins.

The intestinal juice, succus entericus, or duodenal juice, also contains eight enzymes. Four of these are concerned with carbohydrate digestion, two with protein digestion, and one with fat digestion. The eighth, enterokinase which was mentioned previously, serves as an activator for trypsin of the pancreatic juice. Secretion of the intestinal juice is under the control of two hormones, enterocrinin and secretin (the latter also contributes to the control of the flow of the pancreatic juice). In addition both the nervous system and mechanical stimuli contribute to the secretion of the intestinal juice. The secretion varies at different points along the intestinal canal. Its pH is usually about 8.3 and, since it is difficult to obtain intestinal juice, its components are far from clear. It is not at all sure if these enzymes are actually secreted here.

The four enzymes concerned with carbohydrate digestion are *amylase*, *sucrase*, *lactase*, and *maltase*. These reduce the carbohydrates into their constituent monosaccharides. *Aminopeptidase* splits off an amino acid from a peptide at the end having a free amino group, and *dipeptidase* completes the final breakdown of proteins to amino acids. The bile salts activate an *intestinal lipase*, but it is doubtful if it is very effective.

Bile, which is prepared by the liver, concentrated and stored by the gall bladder, is primarily associated with the digestion of fats. The bile salts are a constituent of bile, and their primary function is to emulsify the unemulsified fats, thereby rendering them more accessible to the digestive enzymes. Other functions of bile associated with digestion are the accelerating action of pancreatic lipase and being alkaline it helps to maintain the proper pH of the small intestine. Bile also has a major function in aiding the absorption of the fatty acids and the fat soluble vitamins. It is believed that the secretion of bile is subject to the control of the hormone cholecystokinin, however the most effective stimulus for flow of bile is fatty food. Thus, bile is not a digestive enzyme in the strict sense of the word. About one pint of bile is poured into the duodenum daily. When, for any

reason this does not occur, fat absorption is halted and fatty acids are excreted in the stool; both fat and fat soluble vitamins are thereby lost. Bile has a retarding action on intestinal putrefaction and stimulates peristalsis

Just as food is carried after swallowing (deglutition) into the stomach by **peristaltic action**, so it is propelled throughout the length of the gastrointestinal tract. At intervals it is pushed back by an antiperistaltic wave, only to be carried forward again and further admixed by rhythmical movement or series of local constrictions. These three types of movement produce ideal conditions for digestion and absorption throughout the small intestine



Fig 15 - A bit of the lining of the small intestine is shown cut through and extending away from the observer. The eminences are villi with capillary nets inside. The slender pits are glands. (From Stiles Human Physiology W. B. Saunders Co.)

**Absorption** takes place readily from the small intestine, and the greatest part of the available nutrients is therefore, absorbed before the intestinal contents reach the large bowel. The final products of digestion the amino acids from proteins, the fatty acids and glycerol from fats, and the monosaccharides from carbohydrates, are formed slowly and at varying times in the digestive process, and these constituents are taken up by the blood as they become available. Too great concentration at any one place or at any one time is thereby prevented.

The physical make up of the small intestine renders it highly specialized for the duty of absorption. Examination reveals the presence of many cross folds, visible to the naked eye. It

the microscope tiny fingerlike projections or villi are seen, much like the nap on velvet. These make it possible for innumerable epithelial cells to come in contact with the intestinal contents. Here, again, the efficiency of hormonal control is evident. Villin stimulates the villi of the intestine to wave more rapidly. This makes it possible for the villi to conserve energy when food is absent from the intestinal tract.

On the inside of the intestinal wall is the intestinal contents; on the outside of the membrane is lymph bathing the cells, and running about both are the capillary vessels carrying blood. Formerly it was believed that the major part of the digested food particles "soaked" through the epithelial cells of the villi, passed through the lymph, and entered the capillaries. However, recent evidence indicates that the cells actively participate in the process of absorption instead of assuming the role of a "passive filter barrier." It has been suggested that there are four factors which occur in the absorption of foods: diffusion, osmosis, solution, and electrical properties. A discussion of the characteristics of these four factors is beyond the scope of this book. The possibility has been proposed that there are still many unknown factors associated with this complex mechanism, absorption.

Carbohydrates are believed to be absorbed by a dual procedure: diffusion and phosphorylation. This latter exists when the simple sugars combine with phosphoric acid. Members of some of the B complex are necessary for this reaction to take place. The rates of absorption vary, with galactose being most rapidly absorbed, glucose second, and fructose third.

The water-soluble amino acids pass through the intestinal wall by diffusion. It has been suggested that some intact protein molecules may be absorbed, but this probably occurs under certain conditions and to a limited extent.

There is a variety of beliefs concerning the absorption of fats. The glycerol fraction is water-soluble and is believed to follow a pathway similar to that of the carbohydrates. Some believe that the combination of bile salts and fatty acids pass into the cells of the wall of the intestine, are recombined into true fats (different from the original food fat), pass into the lymph, and then into the large thoracic duct. The bile salts are released and then returned to the liver for future use. Others have found

evidence to suggest that some food fat may be dispersed in a very fine emulsion so that it can be absorbed intact. The newer partition theory has demonstrated that a mixture of bile free fatty acid and a monoglyceride can emulsify fats to a state fine enough for absorption. In absorption these mixtures do not pass through the lymphatic system but directly to the blood.

Little is known about the modifications of minerals throughout the intestinal tract and the factors influencing favorable absorption. Since each mineral seems to be affected differently the problems of absorption will be discussed in the chapter related to minerals. Similarly the absorption of each vitamin will be discussed in the sections concerned with both the fat soluble and the water soluble vitamins.

After absorption a variety of uses awaits each of the food stuffs carbohydrates, fats and proteins. As indicated in Chapter 2 the primary function of carbohydrate is to provide energy for the body. The monosaccharides, galactose and lactose are converted (by an unknown mechanism) in the liver to glucose. The glucose content of the blood is the means whereby the cells throughout the body receive their energy. Thus if necessary immediately upon absorption glucose may circulate in the blood to meet the energy needs of the body. In fact as will be discussed in detail in the chapter on Diabetes Mellitus the glucose level of the blood rises considerably following a meal rich in carbohydrates. If the carbohydrate content is in excess of the immediate needs of the body it is thought to be converted to glycogen as a temporary fuel reserve. Most of the glycogen is stored in the liver, however there are small amounts found in the tissues. This conversion is believed to be a phosphorylation process (in combination with phosphorus) and again members of the B complex are necessary for this action as well as the hormone insulin. However if the carbohydrate intake is high the excess will be changed to adipose tissue to serve as a reserve fuel.

The fats not used immediately for protoplasm can be used as fuel. In this process the fatty acids must be oxidized in the liver and choline, one of the B complex vitamins is necessary for this reaction. The tissue cells complete the oxidation of fatty acids for fuel. Again other members of the B complex must be present. Fats that are not needed for protoplasm or for fuel are converted to adipose tissue to serve as a reserve fuel.

Amino acids are absorbed and circulated rapidly in the blood for a few minutes. If any cell needs a particular amino acid, it will "pick it up" from the blood as the acid circulates. An immediate need for amino acids may be for protein synthesis. This may be either for upkeep of body proteins, for new tissue such as in periods of growth, or for the manufacture of amino acid derivatives, like hormones and enzymes. In the synthesis of protein, the body can synthesize all but the essential amino acids. This is done by a process in the liver in which "transamination," whereby the amino group (the nitrogen fraction) is transferred from one amino acid to another, may be a part. When the protein intake is beyond the body's need for amino acids, the amino group is detached by liver action from the non nitrogenous fraction of the amino acid. This is a process known as "deamination." The amino group containing the nitrogen is sent to the kidney, where it forms ammonia, which usually combines with carbon dioxide to form urea and is excreted in the urine. The non nitrogenous fraction, then, is free to enter into a variety of reactions. If necessary, it may serve as an immediate source for fuel and be converted into glucose. Or, it may be converted into adipose tissue to act as a reserve store of fuel for the body. All of these reactions are believed to take place in the liver.

In the large intestine the residual matter becomes more and more solid as it passes toward the anus. Very little absorption other than of water takes place here and no digestive process. The large intestine is a storehouse for the convenience of the active small intestine much as the stomach is a storehouse.

The feces or stool contains the end products of the ingested food which are, however, only a fractional part of the total fecal mass. Bacteria, bits of epithelial cells, remnants of digestive juices, products of bacterial decomposition, inorganic salts and traces of undigested food, all go to make up the mass. The volume of fecal matter passed daily is variable, but on an average diet it is between 100 and 400 gm. as moist weight, or 25 to 100 gm. of dry material.

Approximately eighteen to twenty four hours elapse from the time of ingestion of food and final elimination of its waste products in the stool. As long as four to five days, however, is not altogether uncommon.

Bacterial action in the intestinal tract may become a matter of importance. At birth the digestive tract is sterile and in adult life it is estimated that perhaps one hundred billion bacteria may act upon the intestinal contents daily. The action may be either harmful or beneficial. Under certain conditions attempts are made to alter the type of intestinal flora or bacteria through food adjustment. Putrefaction of proteins and fermentation of sugars or either alone may appear if gastrointestinal activity is slowed. Constipation and diarrhea likewise are caused by abnormalities in the digestive tract.

The term **digestibility**, when speaking of foods has a variety of meanings. In popular thinking the digestibility of a food usually refers to the ease or comfort with which it is digested. However in the strict scientific sense digestibility usually means the degree that foods are digested in the digestive tract. This latter connotation is called the "coefficient of digestibility" and is expressed in terms of percentages. A far larger percentage of food is digested and absorbed than is generally realized. On an average 95% of all edible foodstuffs is digested and absorbed. 92% of the protein 90% of the fat and 98% of the carbohydrate according to studies made by Atwater.

The popular conception of digestibility the comfort of digestion can be understood when seen in relation to the rate of digestion of various foods. It was pointed out that fats and mixtures of protein and fats are the last foods to leave the stomach. In addition fats may produce an inhibitory effect on gastric secretion. Thus after a meal rich in fats the individual experiences strong satiety value and may have a feeling of "fullness" for some time. When foods are improperly fried fat may coat the protein and carbohydrate particles and thereby prevent normal gastric digestion or irritating breakdown products may have developed. Because of the length of time that foods are in the stomach carbohydrates passing through rapidly fats staying the longest the general impression has arisen that one food is easier to digest than another.

Digestion complicated as it may be by psychic factors is dependent upon common sense for its optimum action. The **psychic factors** are too frequently ignored in considering digestive disturbances and in ascertaining the reason for inadequate response to dietary regimen. Any emotion such as anger fear worry



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TABLE 15  
A SUMMARY OF DIGESTION

SITE	ACTIVATOR	ENZYME	SOURCE	REACTION	ADDITIONAL COMMENTS
Mouth	Chlorine	Ptyalin	Saliva	Starch—soluble starch— dextrin—maltose	1 Breakdown of food into small particles through the process of mastication
	Bromides				2 Saliva lubricates food
	Psychic influ- ences				3 pH ranges from 6.4 to 7.3
Stomach	Gastrin (hormone)	Pepsin	Pepsinogen (zymogen) from gastric mucosa	Proteins—proteoses + peptones (characteris- tic peptido linkage)	1 Salivary digestion continues until food mass is acidified
	HCl	Lipase	Gastric mucosa Gastric mucosa	Fats—fatty acids + glycerol (emulsific fat, such as milk, cream, egg yolk)	2 Mechanical mixing of juices with food by means of mus- cular contraction
					3 Three types of stimuli (a) psychic, (b) gastric phase (food), (c) intestinal phase
					4 HCl provides favorable pH for pepsin, swells proteins, stimulates on disaccharides
					5 Not certain if continuous secretion of HCl in man
					6 pH ranges from 1.5 to 4
					7 Fats inhibit gastric secre- tion—through hormone enterogastrone
					8 No general agreement that gastric lipase is secreted
Small intestine	Secretin	Pancreatic juice	Pancreas	pH for gastric lipase is 7.8	9
	Enterokinase (secreted by intestinal mucosa)	(1) Trypsin	Trypsinogen	Proteoses—peptones— polypeptides	1 Mechanical mixing by means of rhythmic contractions, peristalsis, and antiperistal- sis
	Trypsin	(2) Chymo- trypsin	Chymotrypsin ogen	Catalyzes hydrolysis of breakdown polypep- tides—amino acids	2 pH ranges from 8 to 9 3 No general agreement that pancreatic lactase and su- crase is secreted

(3) Carboxy peptides		Splits off amino acid from peptide and having free carboxyl group	
Chlorine Bromine	(4) Amylopsin	Starch—soluble starches—dextrins—maltose	
	(5) Lactase	Lactose—glucose + galactose	
	(6) Sucrase	Sucrose—glucose + fructose	
Calcium salts Bile salts Secretin (hormone) Enterocrinin (hormone)	(7) Steapsin <i>Intestinal juice</i>	Fats—fatty acids + glycerol	
	(1) Amylase	Starches—dextrins—maltose	
	(2) Maltase	Maltose—glucose + glucose	
	(3) Sucrase	Sucrose—glucose + fructose	
	(4) Lactase	Lactose—glucose + galactose	
	(5) Amino peptidase	Splits off amino acid from peptide and having free amino group	
	(6) Dipeptidase	Dipeptides—amino acids	
Gall bladder			
Cholecystokinin (hormone) Fatty food	Bile	Accelerates actions of pancreatic lipase	
	Bile salt	Increases surface tension and therefore aids in emulsification of fats	
		Aids in absorption of fatty acids	
		Aids in absorption of fat soluble vitamins	

extreme fatigue, or excitement, has a depressing effect on the secretion of digestive juices and normal muscular activity. Appreciation of this psychic influence is expressed in the term psychodietetics—the cooperative program of the psychiatrist and the dietitian.

Conversely, happiness, pleasant surroundings, and palatable food are favorable to optimum gastrointestinal activity. Health notions and food fads obviously may be influencing factors. Overeating, undereating, bolting of food, food that is too hot or too cold, excessive spicing, all eventually leave their mark. Postural defects and extreme malnutrition may mechanically interfere with the action of digestion. Thus, good digestion, upon which health is dependent, is due to a combination of many important factors. Table 15 summarizes the process of digestion.

### Review Questions

- 1 What are the four basic steps in the metabolism of foodstuffs within the body? Define each one.
- 2 What are the differences between hunger and appetite?
- 3 What are the organs concerned with the digestion of foods?
- 4 What is an enzyme? How does an enzyme react in digestion?
- 5 What is a zymogen? What is its function?
- 6 How does the cooking of food affect its digestion? Illustrate.
- 7 What are the purposes of mastication?
- 8 What is meant by the term "activator"?
- 9 What are the factors which determine the length of time that food remains in the stomach?
- 10 What are the factors that influence the absorption of the end products of carbohydrate digestion? Fat digestion? Protein digestion?
- 11 List the functions of the liver in the utilization of foodstuffs as described in the present chapter.
- 12 What is meant by "the coefficient of digestibility"?

### Suggested Projects

- 1 Follow the digestion of a glass of milk through the alimentary tract, naming the enzymes, related substances, and the nutrients they affect.
- 2 Analyze the copy of an advertisement which is concerned with a product suggested as an aid to digestion.

## CHAPTER 7

### INDIGESTIBLE FIBER IN THE DIET AND ITS RELATION TO HEALTH

In order that the intestines may properly perform their function there must be present in the diet a certain amount of roughage for the production of bulk. Very few foods are absorbed by the body to the point that no residue is left and there is therefore a certain amount of undigested material naturally present which cannot be considered entirely waste matter because it plays this important role in intestinal activity. Some of our foods naturally leave a rather large proportion of residue for example the whole grain cereals the leafy vegetables and the fruits. In the normal diet there should not be an extreme in either direction. A well planned diet is one that will produce an adequate amount of bulk for optimum gastrointestinal activity.

In addition to the bulk effect Williams and Olmsted found from studies on medical students that a chemical stimulus arises from the action of bacteria on hemicellulose and cellulose. This fermenting material when mixed with the other fecal mass gives a stool of both bulk and soft consistency. Bran carrots corn germ meal beet pulp and cabbage were definitely laxative. Spinach turnip greens cauliflower lettuce celery pears beans peaches apples pears melon and berries were also effective in promoting satisfactory bulk especially when the fruit skins were also eaten.

This roughage bulk residue or indigestible material is of two general classes the harsh or rough roughage such as the bran layer of cereals the seeds of fruits and vegetables and the skins of some foods and the softer roughage which is composed of the indigestible fraction left by most fruits and vegetables. In some conditions it is wiser to plan for the second type of bulk. Bulk may also be obtained by ingesting one of the polysaccharides (see Chapter 2 Carbohydrates) such as guar gum or psyllium seed. These substances after absorbing water from the intestinal tract swell to a soft bulky mass which passes as such through the intestinal tract.

Certain conditions require that bulk content be limited. This may be done by choosing concentrated foods that contain little residue, meats, milk, cheese, eggs, or by choosing such vegetables as the flowerets of cauliflower, the top buds of broccoli, the tips of asparagus, young tender carrots, and other vegetables which might be rubbed through a strainer (puréed) and leave no residue. In serving these vegetables, it is more desirable to present them in their natural form. They have more eye appeal and are more satisfying. Simply peeling fruit and removing the seeds may automatically throw it into this class of foods. The removal of the bran layers, with the adhering germ, from cereal products eliminates a good deal of roughage, but it must be borne in mind that when this is necessary, compensation should be made for the loss of minerals and vitamins contained in the bran and germ. This may be done by returning the wheat germ after it is separated from the bran to the "patent" or milled flour, or reinforcing the flour with crystalline vitamins. Or the wheat germ may be sprinkled on cereals and put into or on other foods and eaten. The germ has a residue content of only about 2% and is an excellent source of the vitamins B and E. A diet containing cereal and several servings of vegetable or fruit, in addition to meat, milk, and eggs, will contain a satisfactory bulk content for the normal individual.

### Review Questions

- 1 Why is it necessary to have some roughage in the diet under normal conditions?
- 2 Distinguish between harsh and soft roughage.
- 3 What foods leave little residue after digestion?
- 4 How could the normal diet be adjusted to low residue or "smooth" diet?

## CHAPTER 8

### ENERGY METABOLISM

Energy intake which is supplied solely by food is transformed in the animal into energy for various activities. This transformation the oxidation of foods by body tissues results in the liberation of heat the maintenance of body temperature and the production of energy for the routine work and for extra physical activity. Both the calorie content of foods and the calorie expenditure of these reactions may be measured directly or estimated by the use of tables which are formed from the results of extensive research.

As Kleiner stated "The demonstration of the laws of conservation of matter and energy has been made again and again for animate as well as inanimate matter. Matter is transformed chemically and physically but none is lost and none gained energy is changed from one form to another but here too there is neither loss nor gain. These transformations of matter which have been described elsewhere can be termed metabolism. Traditionally metabolism has been subdivided into two separate phases anabolism the building up of body tissues and catabolism the breaking down of either tissues or substances. Energy metabolism or the transformation of energy within the body, will be discussed here. This itself as all metabolic reactions is both anabolic and catabolic."

The measurement of energy is in terms of the unit calorie. The calorie is defined as the amount of heat necessary to raise 1 kilogram (2.2 pounds) of water 1° Centigrade (or 1 pound of water 1° Fahrenheit)\*. The oxidation of foods within the body results in liberation of heat. It was Lavoisier the French scientist who demonstrated that the heat from the body was obtained from oxidation in the same way as heat was obtained from any other oxidation. Heat loss from the body can therefore be expressed in terms of calories. Since foods are the source of energy the energy value of foods can be expressed in representative calorie value.

\*This calorie is a nettes called the large calorie to distinguish it from the small calorie which is the heat necessary to raise 1 gram of water 1° Centigrade. Formerly the large calorie was distinguished from the small calorie by the use of a capital C. However inasmuch as the small calorie is very rarely used the term calorie with a small c is now used to indicate the large or kilogram calorie.



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### ENERGY METABOLISM

Energy intake, which is supplied solely by food, is transformed in the animal into energy for various activities. This transformation, the oxidation of foods by body tissues, results in the liberation of heat, the maintenance of body temperature, and the production of energy for the "routine" work and for extra physical activity. Both the calorie content of foods and the calorie expenditure of these reactions may be measured directly or estimated by the use of tables which are formed from the results of extensive research.

As Kleiner stated: "The demonstration of the laws of conservation of matter and energy has been made again and again for animate as well as inanimate matter. Matter is transformed chemically and physically but none is lost and none gained; energy is changed from one form to another, but here too, there is neither loss nor gain." These transformations of matter, which have been described elsewhere, can be termed metabolism. Traditionally, metabolism has been subdivided into two separate phases, anabolism, the building up of body tissues, and catabolism, the breaking down of either tissues or substances. Energy metabolism, or the transformation of energy within the body, will be discussed here. This itself, as all metabolic reactions, is both anabolic and catabolic.

The measurement of energy is in terms of the unit calorie. The calorie is defined as the amount of heat necessary to raise 1 kilogram (2.2 pounds) of water 1° Centigrade (or  $\frac{1}{2}$  pounds of water 1° Fahrenheit)\*. The oxidation of foods within the body results in liberation of heat. It was Lavoisier, the French scientist, who demonstrated that the heat from the body was obtained from oxidation in the same way as heat was obtained from any other oxidation. Heat loss from the body can, therefore, be expressed in terms of calories. Since foods are the source of energy, the energy value of foods can be expressed in representative calorie value.

\*This calorie is sometimes called the large calorie to distinguish it from the small calorie which is the heat necessary to raise 1 gram of water 1° Centigrade. Formerly the large calorie was distinguished from the small calorie by the use of a capital C. However, inasmuch as the small calorie is very rarely used the term calorie with a small c is now used to indicate the large or kilogram calorie.

Lavoisier believed that it was perspiration which regulated heat loss from the body. To substantiate this idea, he constructed an apparatus to measure directly the heat given off by the body of a small animal in terms of the ice melted in a surrounding container. Today the energy metabolism of an animal or human being may be measured much more exactly by a calorimeter based on this early scheme. Lavoisier also realized that it was possible to measure the metabolism indirectly by analysis of expired air which contains the end products of the oxidative processes taking place within the body. The machines in common use today are based upon this latter conception.

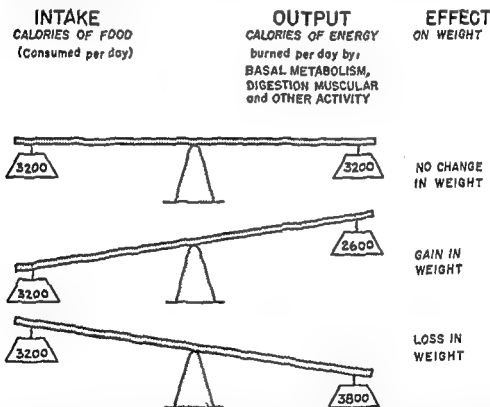


Fig. 16 —Relation of energy intake to energy output. A person's body is made up only of those substances which he has ingested. The human machine stores excess fuel and will burn reserve fuel when the present feeding is inadequate. (From Langston and Anderson, *Health Principles and Practices*, The C. V. Mosby Co.)

Man obtains energy only from the foods that he eats. However, man expends energy in five basic relations: basal metabolism, the specific dynamic action of foods for mechanical work, in the regulation of body temperature, and in the process of

growth and repair. The measurement of energy intake and the measurement of the various channels of energy expenditure will be discussed in detail. Fig. 16 illustrates the relation of energy intake to energy output. When the weight remains the same, the energy intake has equaled the energy expenditure. However, when the energy intake is greater than the energy expenditure, a gain in weight may occur. In the adult, this gain in weight may result in a storage of energy as adipose tissue, or may occur following a wasting illness. Again, a positive energy balance, as this is called, may take place during periods of growth, both in pregnancy and in the growing child as a result of tissue formation. These will be considered again in the appropriate chapters.

### Energy (Fuel) Value of Foods

The energy or the combustion heat value of a food may be determined by burning it (or any other substance desired) in a bomb calorimeter in an atmosphere of pure oxygen (Fig. 17). The heat evolved is measured as a change in temperature of the water surrounding the "bomb." Such determinations indicate that if one takes the *average* value obtained from the different components within the three food groups, it appears

- 1 gm. of pure fat yields 9.3 calories
- 1 gm. pure carbohydrate yields 4.1 calories
- 1 gm. of pure protein yields 4.1 calories

or 9, 4, and 4 calories, respectively. Fat and carbohydrate having the structure C(arbon), H(ydrogen), O(ygen), are burned completely to carbon dioxide and water. Protein, with the structure C H O N(itrogen) P(hosphorus) S(ulfur), yields in addition to carbon dioxide and water a residue, and when correction is made for this incomplete combustion the average value for proteins becomes 4.1 calories per gram.

From a chemical analysis which has resulted in the clarification of the composition of food, the energy value of the food may be calculated. For example, the caloric value of a cup of milk may be calculated in the following way:

	Gm	Cal/Gm	Calories
Protein	8.5	x 4	34
Fat	9.5	x 9	85.5
Carbohydrate	12.0	x 4	48
			<hr/> 167.5 for 1 cup milk

By such calculations and by actual burning of foods in the bomb calorimeter, tables of food values have been prepared. This energy value of foods may be expressed as the amount necessary to yield 100 calories (the 100 calorie portion) (Fig 18), the amount yielded by 100 gm of food, or the calorie yield in the standard portion or "common household units" (detailed table in Appendix). Each form of expression has specific use. When using a list of foods which yield 100 calories each, it is interesting

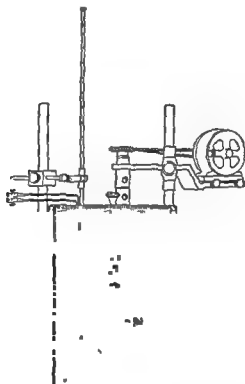
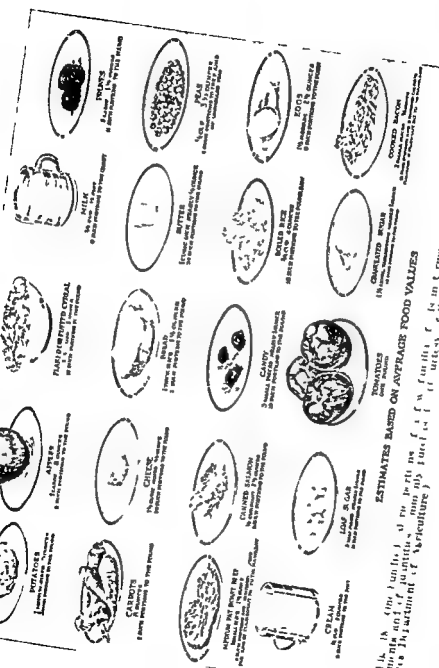


Fig 17—Cross section of Emerson fuel calorimeter (Courtesy Emerson Apparatus Co, Melrose Mass.)

to note the variations in the amount of each food. The tables that contain 100 gm portions automatically represent the percentage composition of food. For example, a 100 gm portion of milk contains 3.5 gm of protein, and, consequently, milk is 3.5% protein. This listing of foods is often used for research purposes. The last list that of the composition of the foods in terms of household units is used for most purposes. In evaluating an individual dietary in calculating food intake of groups of people,



ESTIMATES BASED ON AVERAGE FOOD VALUES

These values are for the food as shown, and not for the food as it is consumed. For example, the value for apples is for the whole fruit, not for the fruit without the skin. The value for meat is for the lean meat, not for the meat with the fat. The value for sugar is for the sucrose, not for the glucose. The value for alcohol is for the ethanol, not for the methanol. The value for caffeine is for the caffeine, not for the theophylline. The value for nicotine is for the nicotine, not for the tar. The value for vitamins is for the vitamins, not for the minerals. The value for minerals is for the minerals, not for the vitamins. The value for amino acids is for the amino acids, not for the proteins. The value for proteins is for the proteins, not for the amino acids. The value for lipids is for the lipids, not for the carbohydrates. The value for carbohydrates is for the carbohydrates, not for the lipids. The value for nucleic acids is for the nucleic acids, not for the proteins. The value for water is for the water, not for the other components. The value for oxygen is for the oxygen, not for the other components. The value for carbon is for the carbon, not for the other components. The value for hydrogen is for the hydrogen, not for the other components. The value for nitrogen is for the nitrogen, not for the other components. The value for phosphorus is for the phosphorus, not for the other components. The value for sulfur is for the sulfur, not for the other components. The value for potassium is for the potassium, not for the other components. The value for sodium is for the sodium, not for the other components. The value for calcium is for the calcium, not for the other components. The value for magnesium is for the magnesium, not for the other components. The value for iron is for the iron, not for the other components. The value for zinc is for the zinc, not for the other components. The value for copper is for the copper, not for the other components. The value for manganese is for the manganese, not for the other components. The value for selenium is for the selenium, not for the other components. The value for chromium is for the chromium, not for the other components. The value for cobalt is for the cobalt, not for the other components. The value for nickel is for the nickel, not for the other components. The value for boron is for the boron, not for the other components. The value for fluorine is for the fluorine, not for the other components. The value for iodine is for the iodine, not for the other components. The value for bromine is for the bromine, not for the other components. The value for chlorine is for the chlorine, not for the other components. The value for phosphorus is for the phosphorus, not for the other components. The value for sulfur is for the sulfur, not for the other components. The value for nitrogen is for the nitrogen, not for the other components. The value for oxygen is for the oxygen, not for the other components. The value for carbon is for the carbon, not for the other components. The value for hydrogen is for the hydrogen, not for the other components. The value for water is for the water, not for the other components. The value for alcohol is for the alcohol, not for the other components. The value for caffeine is for the caffeine, not for the other components. The value for nicotine is for the nicotine, not for the other components. The value for vitamins is for the vitamins, not for the other components. The value for minerals is for the minerals, not for the other components. The value for amino acids is for the amino acids, not for the other components. The value for proteins is for the proteins, not for the other components. The value for lipids is for the lipids, not for the other components. The value for carbohydrates is for the carbohydrates, not for the other components. The value for nucleic acids is for the nucleic acids, not for the other components. The value for water is for the water, not for the other components. The value for oxygen is for the oxygen, not for the other components. The value for carbon is for the carbon, not for the other components. The value for hydrogen is for the hydrogen, not for the other components. The value for nitrogen is for the nitrogen, not for the other components. The value for phosphorus is for the phosphorus, not for the other components. The value for sulfur is for the sulfur, not for the other components. The value for potassium is for the potassium, not for the other components. The value for sodium is for the sodium, not for the other components. The value for calcium is for the calcium, not for the other components. The value for magnesium is for the magnesium, not for the other components. The value for iron is for the iron, not for the other components. 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or in determining the nutrient value of a specific food, it is more practical to use the table of household portions. The nutritive value may be expressed as E.P. (edible portion) or A.P. (as purchased).

It must be recognized, however, that these tables of composition are merely approximations of the actual value of all such foods. There is considerable variation in composition, especially in the vitamin and mineral content. Similar variations were discussed in Chapter 3. These differences may be due to the soil, the weather, the variety of food, the maturity, and the period of storage. In addition, some differences may be related to the method of analysis itself. Table 137 in the Appendix is from the U. S. Department of Agriculture Handbook No. 8, *Composition of Foods: Raw, Processed, Prepared*. It has been included because it is the most recent, universally accepted table which contains suitable values in terms of our American food pattern.

### Energy Expenditure

As indicated previously, the total energy expenditure of the individual is represented by a summation of five factors: basal metabolism, specific dynamic action, mechanical work, heat regulation, and growth. For the most part, the first three are those usually considered, while it is not always necessary to compute the energy expended in the latter two. In each of these expenditures, there are refined, precise laboratory methods for determining the heat produced and there are methods devised, based upon the results of the laboratory research, which are used clinically when it is impossible to carry out extensive examination on each individual patient. Both methods will be briefly considered here.

Basal metabolism is the metabolism of the body at complete rest, in a comfortable position, and comfortably warm and relaxed, both mentally and physically. The patient must also be in a postabsorptive state, i.e., the last meal must have been eaten twelve to eighteen hours previously. Since voluntary activity can be eliminated, and since such activity is extremely variable, metabolism is generally measured under basal conditions.

Basal metabolism as measured is not, however, the lowest level of heat production. Sleep produces a further lowering of from 10 to 13% in the rate. The determination upon a sleeping indi-





free from any condition which might affect their metabolism, we now have tables which may be used in comparing the results on any given individual against this standard. Thus, we may determine the per cent variation the basal metabolic rate obtained is from the standard. A value of +10 means that the individual has a basal calorie expenditure of 10% above the standard. Each individual metabolic rate is expressed as + or - the per cent deviation. A value within the range  $\pm 10\%$  of the average is generally considered normal, however, some clinicians will accept a deviation as wide as  $\pm 20$ .

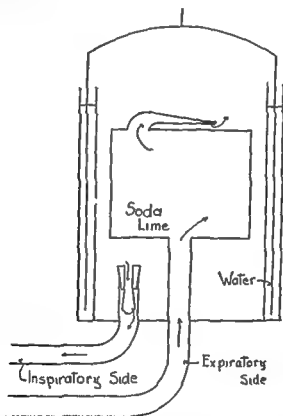


Fig. 90.—Diagram of the connections in the spirometer of the Benedict Roth apparatus. (From Bard: *MacLeod's Physiology in Modern Medicine*. The C. V. Mosby Co.)

There are several factors which normally influence the basal metabolic rate. Among the most important is the relationship of surface area to calorie expenditure which was demonstrated first by Voit and later by Rubner. The metabolic rate may be expressed as calories per square meter of surface area per hour,

TABLE 16  
METABOLISM OF VARIOUS WARM BLOODED ANIMALS

ANIMAL	WEIGHT IN KILOGRAMS	CAL./SQ M./24 HR.
Horse	4410	918
Pig	1280	1078
Man	643	1042
Rabbit	23	776
Fowl	20	943
Mouse	0.018	1188

or per twenty four hours which is the usual method in clinical and experimental studies. That heat production is proportional to surface area rather than to weight is well demonstrated by Table 16. It is difficult to estimate the surface area but from experimental studies various tables and 'nomograms' have been worked out so that the surface area may be estimated from the height and weight of an individual.

In addition to surface area the basal metabolic rate is influenced by age and muscle tone. The rapidly growing child and young adult have a higher metabolism than the older person or the aged. The firm muscled athlete uses more fuel than the individual with flabby underdeveloped muscles. It has been reported that undernutrition reduces the metabolic rate as much as 12%. A man probably because he has more active tissues and less fat than a woman in proportion to his actual weight has a higher metabolic rate. Glandular disturbances or conditions in which fever is present likewise influence metabolism. An approximate increase of 7% in metabolic rate occurs for every degree Fahrenheit of increase in body temperature. It has also been suggested that there may be some variation in the basal metabolic rate among races. Evidence has indicated that white individuals often have a lowered metabolism when they live in tropical climates.

### Specific Dynamic Action

The effect of food to increase metabolism over the basal level was called "specific dynamic action" (sometimes spoken of as SDA) by Rubner. Any food ingested in excess of that needed for immediate energy or structural purposes exerts this effect. The feeding of pure foodstuffs indicates that the increase from each is not identical. Roughly the increase from protein is 30 to 40%, from fat 4 to 14% and from carbohydrate 5 to 7%. On the

average, food (which is mixed in terms of proteins, fats, and carbohydrate) causes an increase of some 10% above the basal level. The explanation of this dynamic action is complicated and not clear. Lusk stated that it is produced during the utilization of the food products by the body. In the past it was thought to be the "cost of digestion," but this concept has been disproved. Kleiner suggests, on the basis of current research, that perhaps the explanation to the S.D.A. of all foodstuffs may be the energy required to prepare the non-nitrogenous parts of the molecule for storage.

Whatever its cause may prove to be, this factor may be calculated and added to the basal metabolism as the second area of energy expenditure.

### Mechanical or Muscular Activity

As soon as the individual engages in mechanical work or muscular activity, he increases his energy expenditure and, consequently, his heat production. The determination of the amount of energy utilized in various activities, which, for the most part, is merely an estimation, is difficult. This is usually found to be the most variable of the areas of energy expenditure.

By means of technically accurate metabolism machines, those which measure both  $\text{CO}_2$  and  $\text{O}_2$ , it is possible to determine indirectly exactly the energy expenditure in the performance of various tasks. The subject may be connected to the circuit in the same manner as in the clinical basal metabolism test. He may work in a "respiratory chamber," a large box or room which is inserted into the circuit, or small sampling bags may be hung onto his back and, as work is performed, these may be removed as desired and taken to the laboratory for later analysis of the expired air, or, again, by temperature change of water carried in coils which line the surface of a sealed box, inserted in a ventilated circuit, in which the subject is placed. The increase in water temperature represents the heat given off from the subject's body. The metabolic rate is thus directly measured.

Such machines are too costly and difficult of operation for clinical use. However, only when both the  $\text{CO}_2$  and  $\text{O}_2$  are measured are the data sufficiently accurate for research purposes. From such research a large amount of data is available which are presented in tables such as Table 17. Other tables repre-

sent various activities expressed as the number of calories per hour per pound (or per kilogram) for a man and a woman. Still other such tables show the energy expenditure in terms of the number of calories per square meter of surface area per hour. In using this latter type of table, the surface area of the individual must be calculated according to either a formula or tables set up for that purpose.

An examination of the data presented in Table 17 will demonstrate the wide variations found in different forms of activity. The material for this table was gathered in an early study by H. M. Bedle (Proc Roy Soc, London 94: 368, 1923) and quoted in the White House Conference report on nutrition. The study was made on 45 boys and 45 girls ranging in age from 8 to 18 years, but divided according to height, weight, and general physical capacity, regardless of age into groups averaging 10 children each. The values obtained on one group are sufficient to demonstrate the effect. This group was composed of boys of an average age of  $15\frac{3}{4}$  years, average height of 164 centimeters and average weight of 50.1 kilograms.

Keys, in discussing the use of such tables in estimating the fuel cost of activity above the basal expenditure, made some fundamental observations. He pointed out that these tables have some

TABLE 17  
EFFECT OF ACTIVITY ON ENERGY EXPENDITURE

OCCUPATION	EXPENDITURE
Basal	40.66 calories per hour
Basal	0.68 calories per minute
Sitting	1.04 calories per minute
Standing	1.23 calories per minute
Walking	2.52 calories per minute
Running	5.24 calories per minute
Football	7.32 calories per minute
Gymnastics, etc	2.53 calories per minute
Quad, games, etc	3.12 calories per minute
Outdoor work, heavy, etc	3.31 calories per minute
Outdoor work, summer, etc	3.54 calories per minute
Gardening	2.39 calories per minute
Workshop	2.07 calories per minute
Swim	5.93 calories per minute
Cold bath	3.93 calories per minute
Dressing	1.83 calories per minute
Bed making, etc	2.42 calories per minute
Siesta	1.09 calories per minute
Odds and ends, waiting about	1.80 calories per minute
Violin practice	1.25 calories per minute

interest in that they indicate the broad differences in energy expenditure among different activities and occupations. However, in the light of modern technology, as the nature of work changes, occupations which formerly required large amounts of energy to perform now do not fit into the same groups. In addition, larger groups of people are no longer classifiable in the older "more uniform crafts and trades." There are also wide variations in the ways in which different persons work at the same job so that one individual might expend far more energy than another. Today, with the reduction of hours of the work week, the number of hours that the individual spends in such activities as sports and hobbies is equally as important as the time spent at his occupation.

TABLE 18

PER CENT INCREASE ABOVE BASAL METABOLISM TO ALLOW FOR ENERGY  
EXPENDED IN MUSCULAR ACTIVITY

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20%	for people at "house" or "bed rest." This figure is used when the person is confined to bed, a room chair, or a wheel chair, as following a fracture of the leg, a crippling type of arthritis, a "stroke" or paralysis, heart disease, and in early convalescence from an illness.
30%	for people at moderately restricted activity but who are up and about. This generally includes people in late convalescence when not confined to the house but who are permitted to sit on the lawn, take short motor trips, take short walks, or be a sports spectator. This group also includes most retired elderly people who voluntarily or on doctor's orders restrict physical activity to the minimum sufficient to prevent boredom.
40%	for people with slightly restricted activity. The large group here are housewives who neither do their own housework nor engage in gainful outside work.
50%	for people in the following light or home occupations—the white collar occupations, machinery operators, housewives who do their own work, domestic servants, chauffeurs, and similar workers.
60%	for people who are moderately heavy workers, such as manual laborers, farmers, truck drivers, and expressmen. This also applies to most adolescent children who are obese.
70 to 100%	for people who are engaged in heavy work, such as stevedores, lumberjacks, steel workers, and such.

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(From Jolliffe *Reduced and Stay Reduced* Simon & Schuster, Inc.)

A method for estimating the amount of energy expenditure above the basal which has been widely used is that of adding a calculated per cent increase in fuel production to the basal requirement. Table 18 offers a guide for determining the calculation of the energy expenditure for a given individual for his muscular activity. It is not feasible from the dual standpoint of

TABLE 19

## RECOMMENDED DAILY ALLOWANCES FOR CALORIES\*

(Food and Nutrition Board, National Research Council, November, 1951)

	AGE YEARS	WEIGHT POUNDS	HEIGHT INCHES	CALORIES
Men	25	143	67	3,200
	45	143	67	2,900
	65	143	67	2,600
Women	25	121	62	2,300
	45	121	62	2,100
	65	121	62	1,800
	Pregnant (3rd trimester)			Add 400
	Lactating (850 ml daily)			Add 1,000
Infants	1/12-3/12	13 (6 kg)	24	kg $\times$ 120
	4/12-9/12	20 (9 kg)	28	kg $\times$ 120
	10/12-1	22 (10 kg)	30	kg $\times$ 120
Children	1-3	27	34	1,200
	4-6	40	41	1,600
	7-9	59	51	2,000
Boys	10-12	78	57	2,500
	13-15	109	64	3,200
	16-20	119	69	3,800
Girls	10-12	79	57	2,300
	13-15	108	63	2,500
	16-20	120	64	2,400

\*These calorie recommendations apply to the degree of activity for the reference man and woman. For the urban white collar worker they are probably excessive. In any case the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight.

time and expense to determine by means of an oxidation chamber the energy spent in this way. Use of such estimates as set forth in Table 18 has represented a practical approach to this part of heat production.

Contrary to popular belief mental work does not effectively increase the total metabolism. Investigators have found that mental work only adds 3 to 4% to the total expenditure and for all practical purposes can be ignored.

## Heat Regulation

While the problem of heat regulation is primarily a physiological one, it is important to include a brief consideration in a discussion of energy metabolism. The body of a warm blooded animal has a remarkably constant body temperature. Body tem

perature is the result of a fine balance of the heat production against the heat elimination which is under the control of the central nervous system

The heat production of the body results almost entirely from the oxidation of food. The specific dynamic action may also be added to the total heat production which maintains body temperature. Whenever the temperature of the surrounding atmosphere is lower than the body temperature, reflexes in the skin bring about an increase in the oxidative process which results in a higher production of heat. If the temperature is still lower an involuntary movement of muscles occurs (known as shivering) and even more oxidation takes place thus still more heat is produced.

Heat loss is both voluntary and involuntary action. It occurs by such routes as radiation, convection, conduction, evaporation of water from the skin and lungs, and loss of heat in the excreta. The importance of each factor depends upon many conditions. Among the most significant are the environmental temperature, the humidity, the presence of air currents, the presence or absence of fever, and the kind of clothing.

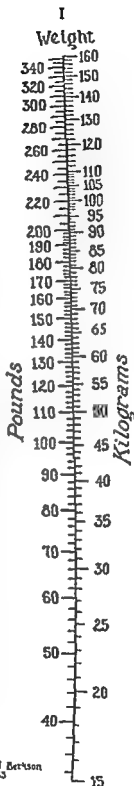
For the most part, the regulation of body temperature is easily maintained by the internal production of heat as the oxidation of food takes place and the regulation of heat loss by the voluntary wearing of clothing and maintenance of a favorable atmospheric temperature by modern methods of heating and air conditioning buildings.

### Growth

Growth itself may be defined as "a net increase in tissue substance." Whenever tissues have been laid down, an increased energy requirement has resulted. This has been very difficult to estimate, however, Jeans has suggested that the energy requirement for growth might be 15 to 20 calories per day per kilogram of body weight. It must be remembered that growth is considered to occur when new tissue formation takes place. Thus such processes as pregnancy, lactation, convalescence with repair of injured tissue, as well as growth during childhood would require additional energy expenditure.

# FOOD NOMOGRAM

*Directions* The standards for age are arranged on the basis of the common method of expressing age as of the last birthday. To determine the desired calorie allowance, proceed as follows (1) Locate the weight on Scale I by means of a pin stuck through the eraser of a lead pencil. (2) Place the edge of the ruler against the pin and swing the other end of ruler to the patient's height on Scale II (3) Transfer the pin to the point where the ruler crosses Scale III which gives the surface area in sq meters (this value need not be read) (4) Holding the ruler against pin on the surface area scale, swing the left hand end of the ruler to the patient's standard for age and sex given on Scale IV (5) Transfer the pin to where the ruler now crosses Scale V which gives the basal heat production of the patient for 24 hours and represents the calories of food required by the fasting patient when resting in bed (basal calories) The calories necessary for activity bear a percentage relationship to those demanded for the resting condition The so-called "white collar worker" when at work will need about 50 per cent more than his basal calories When activity is restricted, as in the hospital, the extra calories necessary will range from 10 to 30 per cent of the basal calories Therefore (6) estimate the per cent of calories above the basal and locate this point on Scale VI With the ruler connect this point with the point located previously on Scale V, and where the ruler now crosses Scale VII read the amount of food calories to be provided by the diet









amples of undernutrition In the United States many cases of undernutrition may be due to physical factors that interfere with food consumption, food absorption, or storage, as well as some factors that are economic in origin

Keys has defined undernutrition as "a condition in which there is no dominant single nutrient deficiency except that of calories" In addition, a primary or secondary protein deficiency may exist, and frequently deficiencies of other nutrients such as the water soluble vitamins and iron, are present

The effects of caloric undernutrition are profound and lasting Among the general effects which are of specific interest here is the general weight loss Keys points out that one of the most constant and important facts in the starved person is a remarkably low basal metabolic rate Using the usual method of measurement, the rate may range from a -10 to a -50, the most severely undernourished persons having a low rate such as -30 to -40% If the basal metabolism is calculated in terms of unit of body weight, it is found that the "rate of oxygen consumption per unit mass of surviving metabolizing tissue is not seriously reduced but the total basal metabolism of the individual may be only half of the amount in the normal, prestarvation state"

The implications of this research may seem remote from the present study of nutrition However, through the FAO and WHO our interest in the problems of international nutrition is high Of direct relationship, however, is the nutritional status of many of our pre and postoperative and chronically ill hospital patients These will be discussed in Part III

### Review Questions

- 1 What does the term energy metabolism mean?
- 2 What unit of heat is used to measure the heat production of the body?
- 3 What is basal metabolism?
- 4 What factors affect the metabolic rate?
- 5 What is the specific dynamic action of food?
- 6 What factor has the greatest influence in raising the metabolism above the basal rate?
- 7 What types of apparatus are used to measure metabolism?
- 8 How is the fuel value of foods measured?
- 9 What does the term undernutrition mean?
- 10 What effect does undernutrition have upon the basal metabolic rate?

### Suggested Projects

- 1 Using the food nomogram (Fig 21), determine your own calorie expenditure. Compare your findings with the recommendations of the National Research Council.
- Does the calorie value of your own menu approximate your estimated calorie expenditure? If not, do you observe a reflection in the deviation in weight gain or loss?
- 3 If possible, either participate in or observe the clinical determination of the basal metabolic rate.
- 4 Using the food nomogram (Fig 21), determine the calorie expenditure for various persons of different age groups that you know. How do your findings compare with the recommendations of the National Research Council for each one?

## CHAPTER 9

### THE BLOOD AND LYMPH

Inasmuch as alteration in blood composition may result in widespread physiological changes, it is of value to know the average composition of blood in order to understand better the effects of deviation from the normal averages. *For the sake of easy reference and review, this chapter is included.* See Table 20 for a summary of values.

Blood makes up 7 to 9% of body weight—a 70 kilo man would have roughly, 10 to 12 pints of blood. A loss of more than half of this at any one time is fatal. Less than half, if restored immediately will usually result in recovery.

Blood is a circulating tissue consisting of a fluid portion called plasma in which are suspended three types of formed elements: the red blood cells (RBC) or erythrocytes, the white blood cells (WBC) or leucocytes (sometimes leukocytes), and the platelets. Dissolved in the plasma are gases and solid materials. The formed elements make up about 45% of the volume of the human blood; the plasma the other 55%.

Blood has eight functions in the body. It carries food material (the metabolic end products of digestion) from the intestines to the tissues and oxygen from the lungs to the tissues. The food materials are in solution, and the oxygen is carried in loose combination with the hemoglobin of the red blood cells as oxyhemoglobin. Blood carries the waste products to the kidneys, lungs, skins and intestines depending upon the point of their elimination from the body. It transports the hormones from the place of elaboration to the seat of action. It brings about a uniform distribution of heat and so aids in the regulation of body temperature. It aids in maintaining acid base and water balance. Last, because of its bacteriological antibodies, blood forms a line of defense against disease.

When whole blood is spun down in a centrifuge so that the fluid and suspended solid parts are separated, it divides into formed elements and plasma. If it is allowed to coagulate or

TABLE 20  
COMPOSITION OF HUMAN BLOOD\*

CONSTITUENT	NORMAL RANGE MG PER 100 ML †	PATHOLOGICAL CONDITIONS IN WHICH INCREASES (UNLESS OTHERWISE NOTED) MAY BE ENCOUNTERED
Total solids %	19.23	Anhydremia Low in hydremic plethora and anemia
Total proteins (serum), %	6.5-8.2	Low in nephritis with edema (nephrosis)
Albumin (serum), %	4.6-6.7	Low in nephrosis
Globulin (serum), %	1.2-2.3	Nephrosis anaphylactic conditions malignancy, infections muscular activity
Fibrinogen (plasma), %	0.3-0.6	Pneumonia infections Low in cirrhosis of liver chloroform or phosphorus poisoning typhoid fever
Hemoglobin % (Haden)	15.6	Polycythemia Low in primary and secondary anemia chlorosis
Iron as Fe	52	See Hemoglobin
Copper	0.05-0.25	
Total nitrogen %	3.0-3.7	Varies chiefly with proteins (albumin globulin hemoglobin)
Nonprotein N	25.35	Nephritis, eclampsia etc See Urea N
Urea N	10.15	Chronic and acute nephritis metallic poisoning cardiac failure intestinal or prostatic obstruction some infectious diseases Relatively low in nephrosis
Uric acid	2.0-3.5	Nephritis gout, arthritis eclampsia
Creatinine	1.2	Nephritis
Creatine	3.7	Terminal nephritis
Amino acid N	5.8	Leukemia acute yellow atrophy of the liver severe nephritis
Ammonia N	0.1-0.2	Terminal interstitial nephritis
Undetermined N	4.18	Eclampsia
Glucose	70-100	Diabetes pregnancy severe nephritis
Total fatty acids	290-420	Diabetes nephritis
Cholesterol	150-190	Diabetes nephritis nephrosis biliary obstruction pregnancy Low in pernicious anemia
Lipid phosphorus	12.14	Diabetes nephritis pregnancy In anemia low in plasma high in cells
Total acetone bodies (as acetone)	0.8-5.0	Diabetes
Acetone + acetoacetic acid (as acetone)	0.1-2.0	Diabetes
$\beta$ -Hydroxybutyric acid (as acetone)	0.5-1.0	Diabetes
Bilirubin	0.1-0.25	Biliary obstruction hemolytic anemias Low in secondary anemia
CO <sub>2</sub> capacity (plasma) vol %	65-75‡	Respiratory diseases tetany Low in diabetes nephritis
CO <sub>2</sub> content (arterial blood) vol %	45-55‡	Respiratory diseases tetany Low in diabetes nephritis
CO <sub>2</sub> content (venous blood) vol %	50-60‡	Respiratory diseases tetany Low in diabetes nephritis
O <sub>2</sub> capacity vol %	16-24‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
O <sub>2</sub> content (arterial blood) vol %	15-23‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
O <sub>2</sub> content (venous blood) vol %	10-18‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
Ascorbic acid	0.8-2.4	Low in scurvy
Lactic acid	5-20	Exercise eclampsia
Phenols (free)	1.2	Intestinal obstruction peritonitis anemia nephritis
Chlorides as NaCl	450-500	Nephritis cardiac conditions prostatic obstruction eclampsia anemia Low in diabetes, fever and pneumonia
Sulfates inorganic as S (serum)	0.9-1.1	Nephritis
Phosphorus inorganic as P (plasma)	3.4	Nephritis Low in rickets Normal values 1.2 mg higher in children
Calcium (serum)	9.0-11.5	Low in infantile tetany severe nephritis parathyroidectomy
Magnesium (serum)	1.3	No changes noted in disease
Sodium (serum)	330	Low in cases of adrenal deficit
Potassium (serum)	16-22	Pneumonia acute infections occurs rarely in uremia
Iodine $\gamma$ per 100 ml	8-15	Hyperthyroidism Low in cretinism

\*From Hawk Over and Summerson: *Physiology and Chemistry of Man*, Philadelphia 1947. The Blakiston Company.

†Figures express concentration in mg per 100 ml of whole blood unless otherwise indicated in the first column.

‡Figures represent weighted averages of the observations of several investigators.

clot, it separates into formed elements and serum, which is essentially plasma minus fibrinogen, the fibrinogen having been used up in the clot formation (see Clotting)

The erythrocytes or red cells are the hemoglobin containing, and therefore, the oxygen carrying, cells or corpuscles. The leucocytes or white cells are the disease resisting cells. The platelets participate in clot formation. The red cells are the heaviest portion of the blood and, therefore, appear after centrifugation as a thick, red, gelatinous mass in the bottom of the tube, while the white cells appear as a thin, creamy layer on top. The platelets are not visible.

The erythrocytes vary in number in normal blood, depending upon age, sex, geographic location, and the degree of activity and hydration of the individual. Approximately 5,000,000 cells per cubic millimeter of blood is the average number for men, the number is slightly less for women. The number present, as well as their physical structure, may be determined by microscopic examination (blood count), and these factors are of diagnostic value.

The hemoglobin (Hb), a protein iron compound, is the red coloring matter of the red blood cells. Human blood contains roughly 15.6 gm Hb per 100 cc. The iron content of the hemoglobin gives to it the property of carrying oxygen without itself being oxidized. If the percentage of hemoglobin or the total number of corpuscles is below average in number, the oxygen carrying capacity is affected and anemia results. Hemoglobin unites with oxygen to form oxyhemoglobin, which is a brilliant red. As blood leaves the lungs (arterial blood), it is bright red in color due to this oxygen content. After circulation, with the removal of oxygen by the tissues and the uptake of carbon dioxide as a tissue waste product, the blood returns to the lung as dark red (or purplish) venous blood due to its low oxygen content and its reduced hemoglobin. In the lungs the carbon dioxide is expelled, oxygen is again taken up, and the blood starts on another trip around the body. A drop of blood makes the complete circuit in about twenty seconds. The average life of the red blood cell is from 110 to 130 days, therefore about 40 to 50 cc of blood is destroyed and replaced daily.

Each 100 cc of normal plasma—and there are some 5 to 6 liters in the adult—contains 7 to 8 gm of protein. Of this 60% is

serum albumin 35% is serum globulin and 5% is fibrinogen. Traces of prothrombin are also present. This protein fraction is of great importance.

Whenever the proteins of the blood are appreciably decreased serious changes take place. One of the functions of the blood proteins is to help control the water exchange between the blood vessels and the surrounding tissue. When blood proteins fall fluid is lost into the tissues and edema or dropsy results. 'War edema', 'prison dropsy' and 'hunger swelling' all express the effect of protein restriction in the diet. Protein deficiency occurs in severe hemorrhage with extensive burns in general peritonitis and in certain gastrointestinal tract disorders where protein utilization is impaired as well as when the dietary intake is inadequate. Failure to maintain the normal concentration of the plasma proteins hence normal blood volume results in circulatory failure or surgical shock. The value of transfusions of plasma in such conditions is well demonstrated by the countless lives saved since Pearl Harbor.

Recently it has been found practicable to use commercially prepared amino acids or a protein digest when sufficient whole blood or plasma is not available or when higher concentrations of protein are immediately desirable. Amigen (a mixture of amino acids and the smaller polypeptides made by enzymatic hydrolysis of casein and porcine pancreas) is such a product. Flinn reports having successfully given as high as 400 gm of this product daily.

It has been shown that for every gram of plasma protein lost 30 gm of dietary protein must be used for replacement. Decreased plasma protein reflects tissue protein loss of a far greater extent. This indicates the need for a high protein intake as replacement. This is a matter to which blood donors especially those repeatedly giving blood should pay heed. To replace the protein removed by the usual 500 cc donation requires approximately 100 to 120 gm of protein over and above the normal need. Five hundred cubic centimeters of blood represents a loss of roughly 20 mg iron. If all of the 12 mg recommended daily could be diverted to replacement which cannot be done it would take 21 days. So the diet following blood donation should be directed toward restoration of iron as well as protein. Vitamins of the B complex and vitamin C are also of importance.



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Whole blood, by transfusion, is used chiefly to replace blood loss. The red blood cells may be used to treat or to prevent anemia, except when the condition is due to blood loss or infection. Plasma is used to prevent or to treat shock or in hypoproteinemia.

Expressed as to chemical composition, the blood is made up of 75 to 80% water, 20% protein, 1 to 2% fat, 0.1% glucose about 2% inorganic salts—the sulfates, phosphates, chlorides and bicarbonates of calcium, sodium, potassium, and magnesium—and the nitrogenous substances—urea, uric acid, creatinine, creatine, and ammonia. In addition, there are enzymes, hormones, and immunizing agents.

### Clotting of Blood

The mechanism that prevents the complete outpouring of blood which would otherwise occur when a blood-carrying vessel is cut is a complicated procedure in which many factors play a part. By means of a chain of events, and the original presence of calcium salts and an antithrombin in the circulating blood, the fibrinogen, which is in soluble form, becomes converted into an insoluble fibrin, a threadlike mass of protein, which enmeshes the blood cells and forms a clot. Vitamin studies have revealed that another factor, vitamin K, is essential. If this vitamin is absent from the blood stream, prothrombin (one of the intermediary substances) is not normally formed, the process of clot formation is interrupted, and the blood fails to clot with normal rapidity. The coagulation or clotting time is prolonged. Administration of vitamin K corrects the difficulty at once (see Chapter 11, Vitamin K).

### Lymph

Blood is not the only liquid that transports material to different parts of the body. The lymph, a form of blood serum, bathes all body tissues. It is the fluid outside the blood vessels and around the body cells. Lymph between organs and body walls is known as pleural or peritoneal fluid. It is also spoken of as tissue fluid.

Under pressure, fluid seeps through the capillary walls into the outlying tissue—fluid in which minerals and protein are held in solution. The water and minerals are able to reverse their direction and pass back into the capillaries. Not so the protein,

unless it were picked up by the lymph it would be a nutritive loss, and too, protein accumulation outside the blood vessels would upset the osmotic pressure and water would likewise be retained causing edema. The lymph absorbs the protein laden filtrate and carries it along with the fat back to the blood stream via the thoracic duct.

There are no vessels corresponding to arteries in the lymphatic system, hence there is no real lymphatic circulation. There are however, channels or tubes (the lymphatics) that begin in the open spaces between a capillary and a cell through which lymph flows slowly from all parts of the body toward the thorax where the greater part of the lymphatics which have been uniting again and again into ever larger tubes join in forming one big tube the thoracic duct. This duct empties into the venous blood system at the junction of two large veins in the neck.

### Review Questions

- 1 Of what is blood composed?
- 2 What are its functions in the body?
- 3 What are the red cells of the blood called?
- 4 What is their function?
- 5 What are the white cells called?
- 6 What is their function?
- 7 What is the average number of red cells per cubic millimeter of blood?
- 8 What is hemoglobin? What function does it perform?
- 9 When the number of red cells or the percentage of hemoglobin falls below normal what is the result?
- 10 Why is the presence of protein important?
- 11 What is the importance of vitamin K in blood clotting?
- 12 What is lymph? How does it function?

## CHAPTER 10

### THE ENDOCRINES AND THEIR ROLE IN NUTRITION

While at first thought a discussion of the endocrines, those organs which secrete powerful regulatory substances into the blood, is outside the realm of nutrition, their hormones are important factors influencing the structural and nutritional condition of the body and should be mentioned briefly. *They are discussed here for those who are interested*

In the early history of medicine various diseases were attributed to a lack of mysterious substances, supposed to be normally supplied by the various organs. Treatment of such diseases consisted of an attempt to supply the lacking substance. Opothrapy (organotherapy) was the name given to this type of treatment. The brain of a hare was administered for nervousness and liver was given for disorders of the liver. In 1849 Berthold described the effects of castration in a fowl. He showed that implantation of testicular tissue could prevent the onset of the symptoms which follow this operation or could counteract the effect of the castration after these symptoms had appeared thus proving that there was a secretion produced by at least some of the organs which could cause widespread effects. Borden, a physician at the court of Louis XV, believed that every organ in the body "is a workshop of a specific substance which passes into the blood." He thought that the physiological integration of the body depended upon these substances. In 1889 Brown Séquard treated general debility in himself by injections of testicular extracts and reported highly beneficial results.

The name **hormone** (excitor) was given to these secretions under the mistaken concept that they always had a stimulating action. This is not always true, for the action of some hormones may be depressant or circumstances may determine just how the hormone may act (see Chapter 6, Digestion).

The known **organs of internal secretion** are the pituitary (or hypophysis), the pancreas, adrenals, thyroid, parathyroid, gonads (sex organs), and the intestines. They all produce hormones.

The pineal and thymus glands may possibly belong to this list, although little is as yet known about their secretions. The known hormones are specific and are powerful in their action.

### The Thyroid Gland

The believed functions of the thyroid gland are twofold: it has an important effect on the growth and development of the body and it also has a stimulating effect on total metabolism.

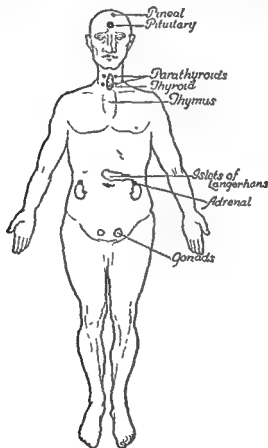


Fig. 24.—Distribution of endocrine glands. (From Williams' *Personal Hygiene*, Appleton W. B. Saunders Co.)

The thyroid gland is especially related to nutrition as its hormone contains more than half the iodine in the body. This hormone is accepted by many as thyroxine, however, it has been suggested recently that thyroxine may not be the actual hormone of the thyroid gland. The mother substance of thyroxine is the amino

acid tyrosine. Tyrosine has been proved to be one of the nonessential amino acids. It can be readily synthesized in the body from the essential amino acid phenylalanine—a compound of similar structure. The reaction, however, is not reversible.

A goiter constitutes any enlargement of the thyroid gland (except those of an inflammatory or a malignant condition). A simple goiter usually develops when the hormone produced has a low iodine content. It has been suggested that this is due to low iodine content of the food eaten. In certain geographic areas, because of the low iodine content of the water and the soil, which is in turn reflected in the food, this type of goiter



A.

B.

Fig 25 —A, Case of myxedema. B, same after seven months treatment (After Tigerstedt from Bard Macleod's Physiology in Modern Medicine)

(also known as colloid goiter) is endemic. The thyroid gland may grow to enormous size, up to 2 pounds or more in weight, probably as the result of an adaptive reaction. The gland attempts to compensate for the low quality of the secretion by excessive production. This latent condition is precipitated frequently during periods of physical strain, such as adolescence or pregnancy.

Marine, in his classical experiments with large groups of school children, has shown that the occasional administration of iodine to potentially goitrous children will prevent its de-

velopment in the large majority of cases. The commercially prepared iodized salt is a logical compensation for low food iodine especially in goiter belts and is of value in the prevention of simple goiter. However, in spite of the extensive use of iodine in these areas simple goiters have not completely disappeared. Thus it has been suggested that a low intake of iodine is not the single factor in bringing about this condition.



Fig. 26.—Illustrating c. tris. 4 and the recovery B after the air pollution.

**Hypothyroidism** occurs when an insufficient amount of chemically normal thyroxine is produced and thrown into the blood stream. As a result the clinical condition called myxedema develops. The patient exhibits a characteristic vacuous expression, is slow of speech and shows general dullness of intellect. There is definite slowing up of all body processes including the metabolic rate which is as would be expected accompanied by



weight increase, unless dietary adjustment is made. Where the deficiency existed at birth or soon after, cretinism develops. Myxedema may arise after normal growth and development have taken place. A specific type of goiter may occur in relation to this condition.

Conversely, an overactive thyroid gland (hyperthyroidism), with increased outpouring of thyroxine, causes an exophthalmic goiter. The goiter is accompanied by bulging, staring eyes (exophthalmia), extreme nervousness, elevated pulse rate, and weight loss due to the increase in metabolic rate, which may be as great as +80 to 90% in severe cases.

### Parathyroid Glands

For a time the parathyroid glands were not clearly differentiated from the thyroid gland. They are now known to have functions entirely distinct from the thyroid gland. Accidental removal of the parathyroids during thyroidectomy has accounted for numerous cases of tetany (muscular spasm or convulsions). The secretion of the parathyroid glands exerts an effect upon smooth muscle by way of its control of the calcium blood level (see Chapter 13).

### The Adrenals

The adrenals, also called suprarenals, one of which is at the upper side of each kidney, produce hormones which play important roles in the body processes. Experimental studies reveal the versatility of action of these secretions. The mammalian adrenal is made up of two parts, cortex and medulla. Each part acts independently. The cortex produces several hormones necessary for normal metabolism. An extract of the cortex is known as cortin. One of these hormones, desoxycorticosterone, is involved in mineral metabolism and, in synthetic form, is used as medication in Addison's disease. Occasionally, due to destructive lesions in the cortex, Addison's disease occurs (see Chapter 34). Characteristic of this condition are anemia, general languor, debility, feebleness of heart action, and peculiar bronzing of the skin. The symptoms become progressively worse until, without other suffering, the patient dies. The treatment or control, which is not entirely satisfactory, consists in the use of cortical extracts and drastic dietary adjustment in mineral in

## THE ENDOCRINES

take. The sodium potassium levels of the blood are disturbed. The sodium falls, the potassium rises. The diet therefore when one is prescribed is high in sodium and low in potassium.

The medulla apparently is concerned in the control of neuromuscular activity. Adrenaline (known also as epinephrine), secreted by the medulla stimulates glycogenolysis (glycogen breakdown into glucose) in the liver and the muscles so helping to regulate the blood sugar level. Adrenaline is probably formed from the amino acid tyrosine.

### The Pituitary

The pituitary (or hypophysis) consisting of two lobes is a small gland about the size of a large green pea situated at the base of the brain. It produces secretions which have a definite effect on growth and development. The pituitary gland is sometimes called the master gland. The hormones from the anterior lobe control growth, metabolism, sex reactions and the gonads which are mutually interdependent for rates of activity. Those of the posterior lobe govern blood vessel tone and urinary secretion. Great advances have been made in the knowledge of the hormones of the anterior pituitary. A number of these active principles have been extracted and purified. The suggestion has arisen as a result of recent research that a fat metabolizing hormone may also be secreted by the pituitary.

If there is overactivity of the gland before puberty (which is itself a result of gonadal changes) too rapid structural growth takes place resulting in gigantism (Fig. 27). When the hyperactivity takes place during adult life acromegaly takes place.

Underactivity or failure of the anterior lobe of the pituitary to develop normally results in the reverse condition dwarfism.

Another clinical manifestation of pituitary insufficiency is Simmonds' disease in which extreme emaciation and premature aging result.

### The Pancreas

The pancreas the long slender organ lying in the bend of the small intestine just below the pylorus produces both an internal and an external secretion. The external secretion (pan-

creatic juice) is discussed in Chapter 6, *Digestion*. It is with the internal secretion, insulin, that we are here concerned. Insulin, produced by the islet cells (the islands of Langerhans, so named for their discoverer), controls carbohydrate metabolism. An inadequacy of insulin results in incomplete oxidation of carbohy-



Fig. 27—Giants and dwarfs owe their abnormal stature to the overactivity or underactivity of the pituitary gland. (Courtesy Press Association Inc. New York.)

drates, high blood sugar, and excretion of sugar in urine, and disturbance in fat utilization (see Chapter 6, *The Fats*). The condition which results is known clinically as diabetes mellitus. This is sometimes spoken of by the laity as "sugar diabetes." The possibility exists that other glands may be involved in this condition.

A combination of diet adjustment and hypodermic use of sufficient insulin prepared from animal tissue can compensate for the individual's discrepancy in insulin production control the clinical condition and return the individual to a state of health in which he can carry on normal activities.

When excessive amounts of insulin are produced and secreted abnormally rapid conclusion of carbohydrate ensues and the blood sugar is held at a level below normal. Clinically this condition is known as hyperinsulinism or hypoglycemia. Dietary adjustment is essential in this condition also.

### The Gonads

The gonads, sex glands (testes, ovaries and their auxiliary structures) determine and control sex characteristics. To a slight extent they also influence the metabolic rate. As sexual activity slows down so does the metabolic rate. Here again overactivity and underactivity of the glands result in definite body changes. The sex hormones are being actively studied today and far reaching results may yet be attributed to them.

As might be expected, since all hormones are blood borne their influence is widespread and abnormalities in any gland can produce abnormalities in other glands until complicated clinical conditions and metabolic dysfunction may result. Wiggers in discussing the interplay of the hormones of the endocrine organs writes: 'No single hormone or endocrine gland acts wholly by itself at any time; the effects are always produced through an interplay of several.' This interplay of the endocrine ensemble controls to a significant extent (a) metabolism (b) growth and development (c) sex functions and reproduction. Consequently it proves didactically expedient to orient oneself with the general ways in which these interacting hormones modify these functions.'

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## CHAPTER 11

### THE FAT-SOLUBLE VITAMINS

It was not until the second decade of the twentieth century that previously unknown substances were identified as vitamins. Since that time, many have been isolated and studied. Vitamins are usually classified according to solubility, i.e., fat soluble and water soluble. The fat soluble vitamins designated are A, D, E, and K. Each serves the individual in characteristic fashion and is also necessary for normal nutrition and health. To date, deficiency diseases are known for vitamins A and D. Generally speaking, the fat soluble vitamins may be stored in the body.

Mankind has long known that certain diseases could be cured by specific foods. As mentioned earlier, centuries ago Hippocrates (500 B.C.), the Father of Medicine, prescribed the liver of the ox dipped in honey as a cure for night blindness. Three centuries ago Cartier described an outbreak of sickness (later known to be scurvy) cured by the "juice and sappe of the leaves of a certain tree." Two hundred years ago Lind proved that the inclusion of a "lime" each day in the diet of the sailors in the English navy prevented the terrific death toll of scurvy. Fifty years ago Takaki found that the beriberi afflicting the Japanese sailors could be cured by adding meat, vegetables, and milk to the polished rice diet then in use.

Magendie (1783-1855) first described an experimentally produced disease by showing that guinea pigs could not survive if fed on a single foodstuff, and that on a mixture of foods health could be maintained. He wrote, "Variety in the diet is an important aid to health." Oliver Wendell Holmes expressed this thought in the *Mind's Diet*—

"No life worth naming ever comes to good  
If always nourished on the selfsame food,  
The creeping mite may live so if he please,  
And feed on Stilton till he turns to cheese,  
But Carl Magendie proves beyond a doubt,  
If mammals try it, that their eyes drop out."

The last line refers to the true vitamin A deficiency which Margendie produced and described

Linn in 1881 fed mice on mixtures of artificial foodstuffs and found that for life "a natural food such as milk" must always be included

Pekelharing (1901) likewise concluded that milk contained an unknown substance of paramount importance to nutrition

In 1912 Hopkins proved beyond doubt that synthetic diets were not adequate for life. So clearly did he summarize his data and the data of others that he is credited with being the first to demonstrate conclusively the existence of a vitamin

In 1912 Funk suggested that the name *vitamine* be given to these hitherto unnamed substances because he thought they were vital amines. This theory has since been disproved and the final *e* has been dropped from the term. It has been shown that vitamins represent a variety of chemical substances their only common characteristic being that they function in minute traces and if absent from a diet specific *deficiency diseases* ensue. In the strict sense of the term a deficiency disease may arise from the lack of any dietary essential protein mineral fat vitamins or other constituents. However in popular usage the term has come to be more or less specific for the conditions developing as the result of vitamin lacks. If a vitamin is completely lacking a condition of *avitaminosis* results if the deficiency is in amount the condition is of *hypovitaminosis*. Subclinical deficiencies (hypovitaminoses) exist and are responsible for some forms of the vague ill health which prevail today.

Vitamins were originally named according to the letters of the alphabet and grouped under the two headings fat soluble and water soluble vitamins but as their chemical structures are becoming known these letters are being replaced by correct chemical designations which indicate their widely varying chemical structure.

Certain definite vitamin deficiency diseases are well recognized xerophthalmia (A) beriberi (B) scurvy (C) pellagra (niacin) and rickets (D) sterility in certain animals (F) bleeding due to lack of clotting (K) and other less specific conditions. All respond with rapidity to vitamin therapy.

In general the well balanced diet which includes milk egg meat cereal fruit vegetable and animal fat adequately supplies



all the necessary vitamins. At times the need is increased, as in pregnancy, lactation, convalescence, and when the metabolic rate is elevated as in fevers and hyperthyroidism. At other times the increased need arises from faulty absorption of fat soluble vitamins A, D, E, and K, due to inability to absorb fat normally. There may be increased need, faulty absorption, or destruction as in cases of gastrointestinal tract disturbances, or a "constitutional inefficiency" may be present. When such conditions exist, the vitamin intake must be adjusted carefully or commercial vitamin products must be employed.

The present widespread use of commercial vitamin products and self medication with them have assumed alarming proportions. Unfortunately, their sales constitute one of the most important items on the drug list. Too many of them have not been prescribed by a physician. These commercial vitamins, it must be remembered, are drugs and should be considered as such.

Vitamin research is an active field and has progressed to the point that it is possible not only to isolate pure vitamins from food products but to synthesize them as well. The vitamin is no longer a vague, elusive something. It is a definite entity. The synthesis of vitamins B<sub>1</sub> (thiamine), B<sub>2</sub> (riboflavin), B<sub>6</sub> (pyridoxine), nicotinic acid, pantothenic acid, choline, para-aminobenzoic acid, folic acid, B<sub>12</sub>, and biotin (members of the vitamin B complex), of C, D, and K, has been accomplished.

Vitamins were discovered through animal experimentation. Synthetic diets containing various food combinations fed to experimental animals made apparent one deficiency after another. Chemists kept pace with the research worker and rapidly isolated the vitamin, determined its chemical structure, and then synthesized the factor involved. Once the chemical structure is determined, methods for chemical detection are found and the assay of various foods to determine their vitamin content becomes possible. It is also possible to determine the amount of vitamin in the blood, urine, spinal fluids, and tissues as a means of measuring the body tissue saturation point for various vitamins. Human studies involving these latter determinations have yielded approximate standards for calculating the dietary intake. If for example, on a generous intake of a specific vitamin a nearly constant amount is retained by the body each day, as evidenced by the difference between intake and excreted

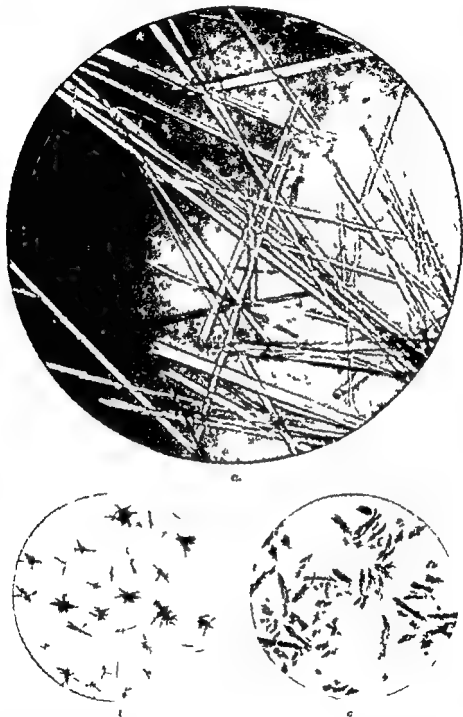


Fig 28—The crystalline vitamins (collected from various sources) a The yellow crystals of vitamin A b thiamine chloride ( $B_1$ ) c riboflavin ( $B_2$ ) (a From *Have You Had Your Vitamins?* by Harry N Holmes copyright 1938 and reproduced by permission of Farrar and Rinehart Inc Publishers b and c courtesy of Abbott Laboratories North Chicago)

amounts, one may reasonably assume that amount to be the daily utilization or recommended intake.

The earlier vitamin studies were concerned with deficiency diseases and curative measures. More recently, however, attention has turned to the specific function of the vitamins—their physiological action in the body and the possible interrelationship of enzymes, hormones, and vitamins. As a result, data regarding the exact mechanism of vitamin activity are accumulating.

With the availability of the crystalline products, progress has been made in the clinical application of vitamin therapy, and methods for detection of deficiencies are becoming more exact. Dr. Jolliffe has stated that "Nutritional inadequacy starts the instant that adequate amounts of any essential nutrient fail to reach the internal environment." He lists the stages of progressive deficiency as: (1) tissue depletion; (2) biochemical "lesions"; (3) altered function, and (4) anatomical lesions. They are clinically recognized, however, in reverse order.

The ability to determine vitamin values chemically has made many detailed studies possible which would not have been possible by the older methods of bio-assay (animal feeding experimentation). Formerly, the vitamin assay of any substance required weeks of laborious animal feeding work. Today these same values for most of the vitamins can be obtained within a matter of hours. It will be remembered that a deficiency of any vitamin results in a slowing up of the growth rate. *Animals grow normally, have good muscular development, well-formed teeth and bones, bright clear eyes, and sleek soft hair only when the diet is adequate in all respects.*

Two additional currently interesting and important phases of vitamin knowledge should be noted. One is biosynthesis, and the other the antivitamins.

**Biosynthesis** is the formation of vitamins within the animal body. This is a new and important finding, since the original definition of the term vitamin includes the idea of "essential substances which must be provided in the diet because the body has been unable to manufacture them." Now it seems some vitamin synthesis can take place in the intestinal tract under the influence of bacteria—a fact brought to light by the use of the sulfonamides and their destructive action on bacteria.

Twenty five years ago it was noted that experimental animals who had access to their own feces did not respond as did those who had not. It was suggested this was due to vitamins present in the feces. This curative effect was called resection. The extent to which this is possible is variable with animals and the various vitamins.

For the present its practical application is an appreciation that it may influence human needs, and that when sulfonamides are given, or any drug, which decrease bacterial action, these may decrease the body's own production of vitamins and so unexpectedly result in deficiency. It indicates the need of high vitamin intake at such times. Research is active on this subject.

The other interesting finding is the existence of **antivitamins**. Not only are there antivitamins but antihormones as well. Isolated facts that had no explanation have gradually been pieced together, until today it is realized that substances very similar to the vitamins exist and that they have neutralizing effect. Apparently the two compete for the same place in the tissue. One, the vitamin, is biologically active and permits normal function. The other is not and when it replaces the vitamin, or exceeds it in amount normal tissue function is hampered. It answers the question of why para aminobenzoic acid could offset the effect of the sulfonamides, why high corn intake is a factor in pellagra, why feeding of raw fish to certain animals results in thiamine deficiency. Research has progressed to a point where antivitamins have been found for thiamine, riboflavin, pantothenic acid, para aminobenzoic, biotin, ascorbic acid, vitamin K, inositol, and folic acid (folic acid).

These findings undoubtedly will have far reaching effects. The requirement values may need alteration, the vitamin values of food may need correction for antivitamin content, to express net vitamin content rather than total. It may be possible to produce deficiency states through administration of excessive amounts of antivitamin which may alter our present concepts. It is complicated, and until the scientist has more time to unravel the mysteries of it we may continue as before in our thinking and practice.

Today there are more than thirty vitamins known to man. In some cases, extensive information has been obtained concerning

the function, requirement, interrelationships, and sources of some of the vitamins. However, much remains to be determined and it is anticipated that unknown vitamins will be discovered as well as additional information offered about those already identified.

A consideration of the vitamins traditionally divides them into two groups according to their basic chemical property solubility. They may be fat soluble or water soluble. The vitamins discussed in this chapter are known as the fat soluble ones and those found in Chapter 12 are water soluble.

### Vitamin A

Until 1913 it was believed that all fats had similar nutritive value. In 1913 however McCollum and Davis and Osborne and Mendel, demonstrated independently that certain fats had in addition to calories some factor necessary in the prevention of an eye disorder occurring in rats. Other fats did not have this protective ingredient. Further, rats could be stunted in growth and misshapen when certain fats were withheld. Cod liver oil was found to be an extremely potent protective oil. Animal fats in general were protective, the vegetable fats were not. To the factor which was responsible for the protective action the name vitamin A was given.

In 1922 McCollum showed that vitamin A was actually two vitamins one protective against eye disorders (antiophthalmic or antixerophthalmic), the other protective against bone abnormalities (antirachitic). The first fraction retained the designation vitamin A and the second became known as vitamin D. McCollum discovered this duality by recognizing that cod liver oil which cured the dryness of the eye and rickets before the oil was treated with hot air ceased to protect against xerophthalmia but continued to cure rickets after the treatment with the stream of hot air. He also realized that certain foods were protective against xerophthalmia and not against rickets, and the reverse. Mellanby in England showed essentially the same results and hence since 1923 the antirachitic fraction has been known as vitamin D.

Vitamin A exists in two forms—as  $A_1$  found in livers of salt water fish and as  $A_2$  in the livers of fresh water fish. Vitamin A as such does not occur in the vegetable kingdom. It exists rather as the precursor or mother substance—the carotenes or caroten

oids. Carotene is converted into vitamin A in the intestinal wall of the animal body. Conversion must take place before the vitamin is physiologically available to the animal. As might be expected in this reaction, loss occurs. Actually, the vitamin value of carotene is but approximately one-half that of vitamin A.



Fig. 29 — Xerophthalmia. The child is suffering from severe xerophthalmia due to a diet consisting largely of skim milk and cereals. At the time this picture was taken (1917) there were many such cases in Denmark due to the war ration. (Photograph of a baby from the practice of Dr. C. J. Block of Copenhagen.)

When data for vitamin content are expressed as carotene, this fact must be kept in mind. It is estimated that two-thirds of the vitamin A content of the average American diet is obtained from carotene and related compounds, whereas one-third is derived as the preformed vitamin.

Vitamin A is fat soluble, stable to heat, acids, and alkalies, but is destroyed by light and is sensitive to oxidation especially in the presence of rancid fat. Recently, vitamin E has been used to prevent the oxidation of vitamin A since vitamin E has been found to have antioxidant properties. In general, it has been suggested that the provitamin is less well utilized than is vitamin A and that it is likely to be destroyed by oxidation in the intestinal tract.

Animals and human beings deprived of adequate vitamin A for a matter of weeks begin to show eye changes and impaired vision. At first there is inability to make light dark adaptation with the sudden change from dark to light, a condition which is commonly called night blindness. The cause is lack of adequate vitamin A in the retina. The enzyme which functions in this regeneration of the visual purple is coenzyme I which is formed from niacin, one of the B complex vitamins (see Chapter 12). The degree of vitamin lack can be measured by a machine known as a biophotometer. As the deficiency becomes more marked, eye changes increase. Concurrent with eye changes is a cessation of growth, a condition which has resulted in vitamin A being called a growth promoting vitamin, which it is. The alteration of growth rate is due to the fact that vitamin A is an essential stimulus for cell formation. This action suggests the value of high vitamin intake in wound healing.

In extreme deficiency, skin changes as illustrated in Fig. 30 may result. The skin becomes dry, normal sweat glands actually are absent, the skin is inelastic, is dull gray in color, and on scratching produces a white, powdery desquamation. Cases reported are said to respond to high vitamin therapy in a few weeks. A relationship between hair loss and brittleness of fingernails and vitamin A intake has been suggested.

Severe vitamin A deficiencies are rare today, but mild deficiency is fairly prevalent. Inadequate intake of animal fat and the highly colored vegetables, or faulty fat absorption will result in such deficiency. Changes in the epithelial tissues are apparent in the eye and also take place in the genitourinary tract and the respiratory system. Predisposition to infection results from the lowered resistance of the altered tissues. It does not follow, however, that one can increase resistance by attempting to overstock the body with vitamin A. This vitamin is anti-

ineffective only when added intake raises a suboptimal level to a normal one. Vitamin A is also necessary for normal reproduction and for lactation in rats.

Fortunately vitamin A can be stored for long periods of time in the body tissues. This is not true of all vitamins. Approximately nine tenths of the stored material is in the liver.



Fig. 30—Cutaneous lesions in vitamin A deficiency showing generalized xeroderma and follicular hyperkeratosis in a Chinese patient with xerophthalmia before halibut liver oil therapy had been given. (Courtesy Dr. Chester N. Frazier from Sutton and Sutton, *An Introduction to Dermatology*.)

In 1919 Steenbock suggested that there was some association between the yellow pigment in foods and vitamin A. In 1931 Moore and Alcott and McCann proved that this colored pigment called *erythene* from carrots, the first known source, could



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# FOODS AS SOURCES OF VITAMIN A

Green, leafy and yellow vegetables are outstanding sources. Dairy products, eggs and liver (and fish liver oils) are the important animal sources. Vitamin A is well conserved in cooking . . . .

CONTRIBUTION OF SELECTED SERVINGS OF A FEW FOODS AS PERCENTAGES OF ADULT MALE ALLOWANCE (5000 INTERNATIONAL UNITS (IU))

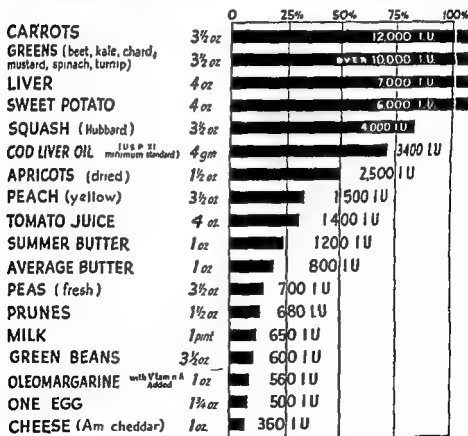


Fig. 31—This table was prepared by a Joint Committee of the Council on Foods and Nutrition of the American Medical Association and the Food and Nutrition Board of the National Research Council. It is reproduced by permission.

be converted into vitamin A in the animal body. It is a precursor or mother substance of vitamin A and is called provitamin A. It has been estimated that the average vitamin A content of the liver may be from 200 to 400 IU per gram. The mechanism whereby vitamin A is mobilized from this reserve store is unknown.

Vitamin A is expressed in terms of International Units (IU). In 1949 a new international standard was established by the Subcommittee on Fat soluble Vitamins of the World Health Organization. Using the new standard the International Unit is equal to 0.344 microgram of vitamin A acetate or 0.30 microgram of the alcohol and makes 0.6 microgram of beta carotene the unit for the provitamin. It is of interest to note that even in a nutrient known as long as vitamin A such basic changes in adapting a new international standard may be made as a result of current research. Nutrition is not a static science.

TABLE 21

RECOMMENDED DAILY DIETARY ALLOWANCES FOR VITAMIN A  
Food and Nutrition Board National Research Council Revised 1953

	AGE yr	WEIGHT kg (lb)	HEIGHT cm (in)	VITAMIN A IU
Men	25	65 (143)	170 (67)	5000
	40	65 (143)	170 (67)	5000
	65	65 (143)	170 (67)	5000
Women	25	55 (121)	157 (62)	5000
	40	55 (121)	157 (62)	5000
	65	55 (121)	157 (62)	5000
	Pregnant 3rd trimester			6000
	Lactating 800 ml daily			5000
Infants	0-1/12 <sup>a</sup>			
	1/12-3/12 <sup>a</sup>	6 (13)	60 (24)	1500
	4/12-9/12	9 (20)	70 (28)	1500
	10/12-1	10 (22)	75 (30)	1500
Children	1-3	1 (27)	87 (34)	2000
	4-6	18 (40)	109 (43)	2500
	7-9	27 (59)	129 (51)	3500
Boys	10-12	35 (78)	144 (57)	4500
	13-15	49 (108)	163 (64)	5000
	16-20	63 (139)	175 (69)	5000
Girls	10-12	36 (79)	144 (57)	4500
	13-15	49 (108)	160 (63)	5000
	16-20	54 (120)	169 (64)	5000

<sup>a</sup>See Table 3 for explanatory footnote

Table 21 indicates the Recommended Daily Allowances for Vitamin A. The National Research Council\* points out that the requirement for vitamin A appears to be proportional to body weight, thus levels of intake which provide 20 IU (6 micrograms) of preformed vitamin A per kilogram of body weight or 40 IU (24 micrograms) of beta carotene have been demonstrated to meet minimal requirements. The allowance has been calculated on the basis of an intake approximately double that of meeting minimal requirements to provide for the maintenance of good nutrition in the total population.

Vitamin A and carotene are abundantly supplied by cream butter, margarine, milk, highly colored fruits, vegetables, liver, egg yolk, and salmon. The vitamin A value of fruits and vegetables is directly proportional to the intensity of color, that is, the deeper the green or yellow, the higher the vitamin content. It has been shown that the deep green outer leaves of lettuce are richer in vitamin A than the paler inner leaves from the same head. Also, as indicated previously, there seems to be a variation in availability of the carotenoids in food which relates to other constituents of the diet. Thus, a diet containing a pint of milk, a serving of butter or fortified margarine, a green, leafy, or yellow vegetable, and fruit, in addition to a protein such as cheese, egg, liver, or dark colored fish, meets the recommended allowance for vitamin A of the normal individual.

### Vitamin D

Like xerophthalmia and other deficiency diseases (see Chapter 12), the disease rickets has been known for centuries. In 1650 Francis Glisson wrote a classical discussion of the subject. In 1922 McCollum showed rickets could be cured or prevented by the addition of certain oils to the diet. The minerals calcium and phosphorus are also factors involved in the occurrence or prevention of rickets (see Minerals, Chapter 13). For normal bone tooth formation, calcium, phosphorus, and vitamin D must be present in proper proportions.

In 1919 it was shown that light rays could heal rickets, the rays from the sun itself or the artificially produced ultraviolet ray. In 1924 it was demonstrated that food could be irradiated by the ultraviolet ray and thereby become capable of curing

\*National Research Council Bulletin No. 302 p. 13

rickets? What power has the sunlight ray? The discovery was made that vegetable and animal tissues (body skin) contain a lipid fraction itself inactive but which could be made active by the ultraviolet ray. Ergosterol in grain and a sterol in animal tissue are precursors of vitamin D or provitamin D. This fact has led to the irradiation of cereals mill etc., and the use of sunlight both natural and in the form of rays from sun lamps.

In 1930 crystalline vitamin D was isolated from crude irradiation products of ergosterol and was given the name calciferol. It has a potency of 40,000 I. S. P. units per gram. It is now known that ten vitamins D ( $D_1$ ,  $D_2$ ,  $D_3$ , etc.) exist. They all have slightly different formulas and are not equally antirachitic.



Fig. 3 —Rickets followed in a diet of 125 cc of whole milk, white bread and 1 lb. and 10 cc of linseed oil per day. The dog, experiment five and one half months. Increase in weight during period of experiment 2670 gm. (Courtesy Controller of H. M. Stationery Office from Medical Research Council Report No. 16.)

Calciferol obtained from irradiation of ergosterol is vitamin  $D_2$  ( $C_{28}H_{44}O$ ). Commercially dissolved in oil it is known as viosterol. From irradiated animal sterol vitamin  $D_3$ , 7 dehydrocholesterol ( $C_{27}H_{44}O$ ) is obtained. Commercially it is known as Delesterol when dissolved in oil.

Since it is a fat soluble vitamin ingested vitamin D is absorbed with the fat of food. Thus any condition that interferes with the absorption of fat will in turn interfere with the absorption of vitamin D. It is stored primarily in the liver and

that values as high as 400 units per quart may be obtained by irradiation. Reinforced or fortified milk contains 400 units per quart. Some margarine is fortified with vitamin D.

### Vitamin E—Alpha Tocopherol, $C_{29}H_{50}O_2$

As early as 1920 Mattill and Conklin found that rats reared on cow's milk were incapable of raising young, even though the milk, as they thought, was adequately supplemented to make an adequate diet. Two years later Evans and Bishop reported that for normal reproduction a definite dietary factor was necessary. This factor, first designated vitamin X and later changed to vitamin E, is now known to be alpha tocopherol, an alcohol having the formula  $C_{29}H_{50}O_2$ . The name signifies its role—*tolos* meaning childbirth, *phero* meaning to bear, and *ol* meaning an alcohol. Actually four tocopherols exist—alpha, beta, gamma, and delta. These differ slightly chemically and in biological activity. The alpha is the most potent biologically.

More than a quarter century has passed since the existence of vitamin E was definitely established. Its first recognized function as an antisterility factor for the laboratory rat has been overshadowed by its demonstrated need for maintenance of structural and functional integrity of skeletal, cardiac, and smooth muscle, and, in some animals, the peripheral vascular system. Tocopherols play an important role as intracellular antioxidants, related especially to the stabilization of ingested fats and possibly of products arising in the metabolic synthesis and degradation of lipids. They may also function in a detoxifying capacity. Morphological alterations arising in the course of vitamin E deficiency may well represent localized reactions of particularly susceptible tissues to loss of these vital antioxidants or secondarily to dysfunction of enzyme systems in which tocopherols actively participate.

The histopathological lesions of E deficiency are remarkably varied; they represent morphological alterations in a number of unrelated tissues. They seem not to be related to dysfunction of any specific type of cell or tissue and they are of such a nature that restoration of normal morphology rarely occurs after tocopherol therapy, even though the physiological or biochemical disturbances are corrected. Most lesions are dependent upon

fat in the diet and their onset and intensity are accentuated in proportion to the amount and degree of unsaturation of the fat used. There are the possibilities that the unsaturated fats destroy dietary traces of the vitamin in the diet or the intestinal tract. They or their oxidation may produce a direct cell injury which is superimposed upon that due to a lack of vitamin E. Excess utilization of tocopherols to stabilize unsaturated fats being incorporated into cell lipids hastens depletion of tissue tocopherols and the precipitation of deficiency manifestations.

— — —



Fig. 34 — A 99 month old rat showing paralysis due to vitamin E deficiency (Courtesy of Dr. C. O. Burr, University of Minnesota, and Havley and Maurer, *Max's The Fundamentals of Nutrition*, Charles C. Thomas, Publisher.)

Conceivably the true picture may represent a combination of these postulated interactions. With these possible interactions in mind the symptomatology and histopathology of experimental vitamin E deficiency may be more comprehensible.

Little is known concerning the requirement of man for vitamin E. On the basis of present knowledge a deficiency symptom in man cannot be set forth. However as described by Putt this does not mean that a relationship of vitamin E to requirement



TABLE 23  
VITAMIN E CONTENT OF FOODS\*

		TOTAL TOCOPHEROLS MG /100 GM FRESH FOOD
<b>VEGETABLES</b>		
Beans, dried navy		3.6
Cabbage		0.11
Carrots		0.45
Celery		0.48
Lettuce, iceberg,	1	0.54
	2	0.68
	3	0.43
Onions		0.26
Peas, green		2.1
Potatoes, peeled		0.08
Potato peels		1.8
Tomatoes		0.36
Turnip greens		2.3
<b>CEREALS</b>		
Cornmeal, yellow		1.7
Oatmeal		2.1
Rice, brown		2.4
Rice, polished		0.57
Wheat products		
Bread, white		0.93
Bread, whole wheat		1.3
Crackers, soda		3.7
Farina		1.6
Flour, white (80% extraction)		1.2
Flour, whole wheat		2.2
Spaghetti		1.2
<b>MEAT, FISH, POULTRY, AND DAIRY PRODUCTS</b>		
Bacon		0.53
†Beef, dehydrated		
Beefsteak		0.63
Lamb chops		0.77
Pork chops		0.71
Fish (haddock)		0.39
Chicken		0.25
Eggs (whole)		2.0
Butter		2.4
Cheese American		1.0
Milk, fresh		0.12
Milk, evaporated		0.30
<b>FRUITS</b>		
Apples		0.74
Bananas		0.40
Grapefruit		0.26
Oranges		0.24

\*We are indebted to Dr. Philip Harris of Distillation Products Inc. Rochester for this table of food values

†Bio assayed

TABLE 23—CONT'D

	TOTAL TOCOPHEROLS	
	MG/100 GM	PER 311 FOOD
<b>FATS AND OILS</b>		
Cottonseed oil, refined		90
Corn oil, refined		87
Lard		27
†Margarine, clarified		51
Olive oil		69
Sorbean oil, refined		140
<b>MISCELLANEOUS</b>		
Apple pie 1		0.20
2		22
3		0.20
Chocolate, unsweetened		111
Peanuts		93

and disease in man will not be established. It simply indicates that, so far, none has been determined.

The vitamin is distributed in nature in the oils of seeds and grains, such as cotton seed or corn wheat germ, and wheat germ oil. Leafy green vegetables and to a lesser extent eggs and meat, are sources of the vitamin. Deficiency is probably rare. The Rochester workers\* have calculated the vitamin E intake in typical diets for health and disease and include that the average American appears to receive about 15 mg tocopherols daily against a calculated requirement of 25 mg. They state "One important fact emerges namely the important place that vegetable fat, exemplified by margarine occupies as a source of vitamin E."

The needs during pregnancy are tentatively set at 50 mg daily.

Synthetic tocopherol (as the acetate) and "concentrates" obtained by distillation are now available. Expression of potency of these products is on a milligram basis.

### Vitamin K—Menadione

Vitamin K, the coagulation (koagulation) or prothrombinogenic factor, is another vitamin belonging to the fat soluble group.

\*Hickman, K. C. D. and Harris, P. I. Tocopherol Interrelationships. Advances in Enzymology. New York 1946. Interscience Publishers, Inc. Vol. 6 p. 469.

It was discovered by Dam (a Dane) in 1929 while he was studying cholesterol metabolism in hens. He observed a peculiar hemorrhagic disease, characterized by a prolonged bleeding time, with some symptoms of scurvy. In 1935 this was shown to be a dietary deficiency disease. Later (in 1936) Dam and his co-workers found this hemorrhagic condition to be due to a decrease in blood prothrombin.

Fatal hemorrhages have been known to occur in the newborn infant at about the third day of life, and experimental work, given impetus by the discovery of vitamin K, has shown that these infants had a prolonged clotting time. It is now known that this prolonged clotting time can be restored to normal by a single dose of 1 mg. of synthetic vitamin K given to the mother before delivery. This single dose will also carry the infant over the critical period. In order to aid in the prevention of the brain hemorrhage at birth, it has been suggested that a daily oral dose of 1 mg. of vitamin K be given to pregnant women during the last month of pregnancy. Hemorrhages due to hemophilia, however, are not corrected by this vitamin inasmuch as the prothrombin of the blood in this condition is not below normal.

The mechanism whereby vitamin K takes part in the production of prothrombin is unknown. Vitamin K is synthesized by microorganisms in the intestinal tract. It is absorbed from the intestine only in the presence of bile. Therefore, any condition which might interfere with the flow of bile may prevent the absorption of vitamin K from foods or from that synthesized in the intestine.

It is extremely difficult to produce a deficiency of vitamin K by dietary restriction. The diet normally supplies adequate amounts as the vitamin is found in most leafy green vegetables, hemp seed, soybean oil, rice bran, and egg yolk. Other rich sources are alfalfa, kale, spinach, dried carrot top, tomatoes, putrefied fish meal, and casein.

Vitamin K is available commercially in two forms, in an oil prepared from alfalfa, and as a synthetic crystalline product, either oil soluble or water soluble. There are several vitamins or substances with vitamin K activity— $K_1$  ( $C_{31}H_{46}O_2$ ),  $K_2$  ( $C_{41}H_{56}O$ ), and others. Potency of the synthetic product, which has been named menadione, is expressed on a milligram basis. For the natural product several units are used. The chick units

TABLE 21

## FAT SOLUBLE VITAMINS—THEIR FUNCTIONS AND IMPORTANT SOURCES

VITAMINS	FUNCTION	DEFICIENCY SYMPTOMS	PRIMARY SOURCES
Vitamin A	Essential for growth Essential for structure and functioning of cells of skin and mucous membranes Aids in tooth and bone formation Aids body to resist infection Aids eyes to adjust to changes from bright to dim light	Retarded growth Characteristic changes in skin and membrane Night blindness Lowered resistance to infection	Fish liver oils Liver Yellow, and dark green leafy vegetables Yellow fruits Cream Butter Fortified margarine Whole milk
Vitamin D	Essential for growth Essential for regulation of calcium and phosphorus in bone and tooth formation Essential for regulating calcium and phosphorus metabolism Aids in absorption of calcium from the intestinal tract	Retarded growth Rickets Poor tooth and bone formation	Sunlight Fish liver oils Fatty fishes Fortified margarine Fortified milk
Vitamin E	Specific function for man unknown Acts as antioxidant for some vitamins, and unsaturated fatty acids Essential for normal reproduction of many animals	Undetermined	Wheat germ oil Cottonseed oil Corn oil Soybean oil Margarine Butter Navy beans Green leafy vegetables
Vitamin K	Essential for normal clotting of blood	Hemorrhages	Green leafy vegetables Pork liver Soybean oil Seeds Fruits Root vegetables

established on the basis of the effect of the vitamin on chicks, are named after Dam, Ansbacher, or Almquist

Dicumarol, the antivitamin of vitamin K, causes a decrease in clotting time. This has been useful clinically to prevent the formation of thrombi. It has been difficult to control and severe hemorrhage could occur. However, recently, methods have been developed whereby the effect of Dicumarol may be quickly negated

One other point rightfully should be discussed under the fat soluble vitamins. This is the use of mineral oil. Mineral oil has been widely used and accepted as a mild purgative. The pros and cons of its value have no place here but its effect on the absorption of the fat soluble vitamins has. Its ingestion seriously interferes with the utilization of carotene, vitamins A, D, E, and K—the fat soluble group. These are absorbed by the oil and leave the body without being released from it, thereby resulting in possible deficiency.

### Review Questions

- 1 What were some of the early observations concerning the existence of food elements other than proteins, fats, and carbohydrates? Who were the scientists concerned with these demonstrations and when did these experiments take place?
- 2 Who named these elements vitamins, and why was this name chosen?
- 3 Before their chemical structures were determined, how were vitamins designated?
- 4 What are some of the recent interesting discoveries related to vitamins?
- 5 What should the human dietary include to supply adequately all the known necessary vitamins?
- 6 What are the primary functions of vitamin A?
- 7 What results from an insufficient amount of vitamin A in the diet?
- 8 What is the difference between vitamin A and vitamin A value?
- 9 What is the daily recommended allowance of vitamin A?
- 10 What are the primary sources of vitamin A in the diet?
- 11 What vitamin is known as the "antirachitic" vitamin?
- 12 Which minerals are also necessary as factors in the prevention of this deficiency disease?
- 13 Which foods supply vitamin D? What are supplements to these food sources?
- 14 What vitamin is essential for normal reproduction in certain animals?
- 15 What is the chief function of vitamin K?

### Suggested Projects

- 1 Examine your own menus. Calculate the vitamin A found in your foods during one day. How does your intake of vitamin A compare with the recommended allowance? What percentage of vitamin A in your diet comes from animal sources? What percentage from provitamin A sources?
- 2 Examine your own menus. Calculate the vitamin D found in your foods during one day. Which foods were rich sources of vitamin D? Were they natural sources or had the foods been fortified?

## CHAPTER 12

### THE WATER SOLUBLE VITAMINS

There are many water soluble vitamins known to man today. The greatest number are found in the group called the vitamin B complex. All are believed essential to human nutrition, however, deficiency diseases have been identified with three vitamins. The water soluble vitamins are easily lost through improper cooking and storage. They are obtained from a variety of food sources. In some cases, it is believed that intestinal synthesis supplements the usual sources. The water soluble vitamins are stored within the body to a limited extent only, so it is necessary to obtain them daily.

The water soluble vitamins consist primarily of vitamin C and the vitamin B complex. Today, we know that the single, water soluble antineuritic, antiberiberi vitamin B no longer exists but that it is a group of vitamins. The water soluble vitamin B described by McCollum and Davis in 1915 as necessary for health and growth in collaboration with fat soluble vitamin A, has undergone many changes. In 1926 Smith and Hendrick found it to be made up of two fractions, the heat labile (destroyed by heat) fraction called vitamin B<sub>1</sub> (antineuritic), and the heat stable fraction called vitamin B<sub>2</sub> or G, or the PP factor, the latter designation because Goldberger found it contained the pellagra preventing factor. Experimental studies with this second fraction (vitamin B<sub>2</sub>) have since shown it to be composed of many substances and not merely a single entity as is vitamin B<sub>1</sub>. Therefore we speak of the vitamin B<sub>2</sub> complex and know that it can be divided into vitamins B<sub>2</sub> (riboflavin), nicotinic acid or niacin, B<sub>6</sub> or pyridoxine, pantothenic acid, biotin, para amino benzoic acid, choline, folic acid, B<sub>12</sub>, and perhaps others. The water soluble vitamins will be discussed under their separate headings.

As indicated in Chapter 3, many cereal products on the market today are enriched with thiamine, riboflavin, and niacin. This increases immeasurably the intake of these essential water soluble vitamins.

### Vitamin C—Ascorbic Acid, $C_6H_8O_6$

For centuries scurvy, the deficiency disease resulting from lack of vitamin C, has been known to be due to a stale diet. Sailors on long sea voyages "fell sick and died" from a typical disease, apparently only because no fresh food was obtainable. In reading the history of scurvy it is all too evident that the knowledge obtained from empirical (experimental rather than scientific) observation was forgotten and rediscovered many times.

In the stories of the Crusades in the middle of the thirteenth century one finds described the spongy condition of the gums which was so severe that "the barber surgeons were forced to cut away the dead flesh from the gums to enable the people to masticate their food". Other descriptions mentioned the prevalent tendency to great weakness and black spots on the legs. Long bones may be rarefied, sometimes fractured at the junction of the shaft and epiphysis, ribs may be swollen and sometimes fractured. In young children there is a typical apprehensive cry from fear of being touched, extreme irritability, and restlessness. Anemia is frequently present.

The first scientific study of scurvy was made in 1757 by James Lind, a surgeon in the English Navy. He took twelve men suffering with scurvy and to each he gave different medication. After 6 days, the pair receiving 2 oranges and 1 lemon daily had improved and one went back to active duty. The other was well enough to be appointed nurse to the other ten who were still suffering. He thereby showed that citrus juice was the only effective cure. As a result of this report, lemons were regularly included in the diet of English sailors and scurvy was practically eliminated. The words "limer" and "limey" arose from this experiment.

Just before the beginning of this century (in 1883), Sir Thomas Barlow described the disease as it occurred in babies, and it became known as Barlow's disease. Babies fed too long on boiled milk and gruels were prone to develop this condition. Today, orange juice included with the formula of a bottle fed baby is a recognized procedure.

The molecular structure of ascorbic acid is closely related to the monosaccharide sugars (glucose, fructose, and galactose). Ascorbic acid, a white crystalline powder, readily oxidized and

rendered inactive in alkaline solution has the formula  $C_6H_8O_6$ . It was originally known as hexuronic acid. Later the term cevitamic acid was given to the crystalline product used for clinical purposes. Now however both chemically and clinically it is called ascorbic acid.

The most clearly established function of ascorbic acid probably is that of maintenance of intercellular substance. In fact, scurvy has been characterized as a condition in which defective intercellular materials are formed. With complete deprivation of vitamin C it has been reported that certain skeletal tissues formed a fluid material rather than their natural products dentine or bone and that the administration of the vitamin causes the liquid to solidify or jell. It has also been suggested that with a deficiency a breakdown reaction occurs which results in the abnormal condition. The exact mechanism of this action is still not proved but at least it is definite that a defective mechanism does result and that the normal process is interfered with. This abnormality of intercellular material permits leakage of blood from the capillaries in the scorbutic individual when pressure is applied.

Inasmuch as vitamin C is necessary for tissue respiration as part of the oxidation reduction system of the body in the absence of the vitamin the body cells cease to function normally and probably this contributes to the breakdown of or failure to build normal body structures. Failure of tissue to heal in the absence or with a deficiency of ascorbic acid has resulted in its widespread and successful use in surgery.

It is also suggested that vitamin C plays a role in combating and neutralizing the toxins of infectious diseases and that it may be concerned in the formation of specific antibodies. Its role in the control of glandular secretion is also under consideration.

Complete absence of the vitamin or its presence in only trace amounts in the diet results in frank scurvy.

Subclinical deficiencies—those instances where the clinical symptoms are not sufficiently definite to suggest the disease immediately but where the more sensitive tests for deficiency can prove its existence—are now recognized. When the vitamin C intake is below the requirement level vague ill health may result and there are a number of symptoms which appear either



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to have a normally high content of vitamin C. According to present knowledge, man, monkey, and the guinea pig are the only species that require ascorbic acid in the diet. All others seem to be able to synthesize the amounts needed.

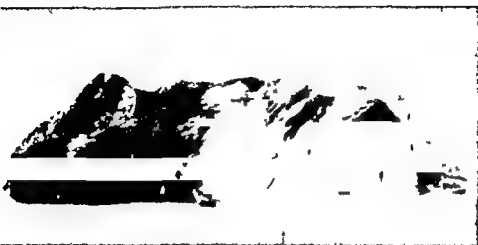


Fig. 36—Vitamin C is needed to prevent scurvy. The guinea pig is suffering with scurvy due to lack of vitamin C. This deficiency also affects the teeth and gums of human beings. (Courtesy Wisconsin Alumni Research Foundation.)



Fig. 37—This guinea pig, a litter mate, has received a diet adequate in vitamin C.

It is generally agreed that the minimum amount of ascorbic acid necessary for the prevention of frank scurvy is from 10 to 20 mg daily. However, as indicated by the National Research

singly or in combinations. Inadequate intake or subclinical scurvy may be characterized by loss of appetite, vitality and weight, irritability and apprehension, muscular weakness, joint pains and swelling, loosening and decay of teeth, spongy gums, hemorrhage—cutaneous, intramuscular, and joint—anemia, rarefaction of long bones, fracture at junction of shaft and epiphyses, gastrointestinal tract disturbances, and predisposition to infections and lesions.

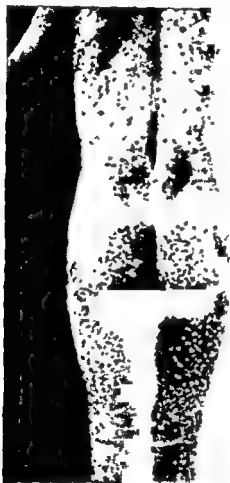


Fig. 35—Due to an increase in the fragility of the capillaries, rupture readily takes place on pressure either constant or abrupt (From Harris *The Vitamins*, Cambridge University Press)

An interrelationship among ascorbic acid, folacin, and vitamin B<sub>12</sub> has been shown experimentally. Also, there seems to be a relationship between vitamin C and the oxidation of two amino acids, phenylalanine and tyrosine. The adrenal glands are known

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It is generally agreed that the minimum amount of ascorbic acid necessary for the prevention of frank scurvy is from 10 to 20 mg daily. However, as indicated by the National Research

Council, the recommended allowances represent an appraisal of all the evidence available which suggest amounts needed by man. The allowances do not represent "saturation" values. It is suggested that intakes which include the amounts of vitamin C found in Table 25 may not be satisfactory for the preservation of optimum health through long periods of time or when the body is subjected to common forms of stress. However, the recommended allowances are more than three times the minimum amount mentioned above.

Ascorbic acid is abundantly supplied by citrus fruits ( $\frac{1}{2}$  cup of orange juice yields approximately 60 mg of vitamin C). Under current commercial processes both canned and frozen citrus fruit juices may be accepted as equivalent in vitamin C potency to the fresh fruit juice. Other fruits, including tomatoes, are good sources. All leafy green vegetables and sprouted seeds are excellent sources. Potatoes, because of the frequency of their

TABLE 25

RECOMMENDED DAILY DIETARY ALLOWANCES FOR ASCORBIC ACID  
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG (LB)	HEIGHT CM (IN)	ASCORBIC ACID MG
Men	25	65 (143)	170 (67)	75
	45	65 (143)	170 (67)	75
	65	65 (143)	170 (67)	75
Women	25	55 (121)	157 (62)	70
	45	55 (121)	157 (62)	70
	65	55 (121)	157 (62)	70
	Pregnant (3rd trimester)			100
	Lactating (850 ml daily)			150
Infants	0 1/12*			
	1/12 3/12	6 (13)	60 (24)	30
	4/12 9/12	9 (20)	70 (28)	30
	10/12 1	10 (22)	75 (30)	30
Children	1 3	12 (27)	87 (34)	35
	4 6	18 (40)	109 (43)	50
	7 9	27 (59)	129 (51)	60
Boys	10 12	35 (78)	144 (57)	75
	13 15	49 (108)	163 (64)	90
	16 20	63 (139)	175 (69)	100
Girls	10 12	36 (79)	144 (57)	75
	13 15	49 (108)	160 (63)	80
	16 20	54 (120)	162 (64)	80

\*See Table 3 for explanatory footnote

use in the menu by many may serve as a good source of vitamin C. However throughout the winter ascorbic acid is lost from the potato and in the late winter or early spring negligible amounts of this vitamin remain. The daily inclusion of a citrus fruit plus a salad assures an intake of around 75 mg, which is the recommended allowance for the adult. (See Table 25)

Storage of food at room temperature results in vitamin loss in nonacid fruits or vegetables. The protective action of the natural acid as occurs in citrus fruits and tomatoes results in excellent retention even in the canned products. The leafy salad vegetables and other fruits are not so protected. Maceration of tissues as in the chopping of salad greens also results in an accelerated loss—a point to keep in mind in holding chopped vegetables unduly long.

The precautions discussed later in the chapter for the handling of water soluble vitamins to prevent destruction or loss apply also to vitamin C. Roughly one half of the vitamin can be dissolved out by the cooking water.

TABLE 26

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 75 MG OF ASCORBIC ACID

FOODS	APPROXIMATE AMOUNTS
Orange juice fresh or frozen	$\frac{3}{4}$ cup
Grapefruit juice canned unsweetened	$\frac{3}{4}$ cup
Tomato juice canned	2 cups
Tomatoes raw	2 medium (300 gm)
Cabbage—finely shredded	$1\frac{1}{2}$ cup (150 gm)
Apples 1 medium—approximately 180 gm each	10 apples
Potatoes baked	1 pound
Strawberries raw capped	$\frac{3}{4}$ cup (130 gm)
Cantaloupe—medium sized	$\frac{1}{4}$ melon
Peas young cooked	1 lb 2 ounces

Adapted from Composition of Foods Raw and Processed Prepared U S Department of Agriculture Handbook No 8

### Vitamin B—Thiamine $C_{12}H_{17}N_4OS$

The disease beriberi has been recognized for many years. The high incidence of this disease led Takaki an officer in the Japanese navy to look for its cause. As only the Japanese navy was affected he deduced that the disease was hereditary or due to their specific dietary which was largely rice. He added meat, milk and vegetables to the rice diet and great improvement resulted.



Eijkman also studied beriberi in the Java prisons about the same time, and, in addition to his studies on human beings, he observed that birds fed on polished rice developed a disease, the symptoms of which resembled those of beriberi. Birds fed on whole rice did not develop the disease. It was, therefore, obvious that rice polishings played some role in prevention of the disease.

Since vitamin B is water soluble and heat labile, it follows that it can be destroyed or lost to varying degrees during cooking unless care is exercised. Its destruction is retarded by acid and hastened by alkali. Thiamine is very stable in the dry form.

Thiamine is essential for normal growth, appetite, tonicity of the gastrointestinal tract, and proper nerve function. Thiamine is also essential for the normal metabolism of carbohydrates. Without one of the salts of thiamine (cocarboxylase), the breakdown or oxidation of carbohydrate is upset, for this reason, the thiamine requirement of the body parallels the carbohydrate intake.

Thiamine is frequently referred to as the morale vitamin. Deficiency of thiamine induces a quarrelsome, "don't care" attitude, reduces efficiency and physical ability, and produces digestive disturbances, while vague symptoms of ill health accompany a feeling of nervousness. In addition, research has indicated that thiamine may be necessary for the metabolism of tryptophane, one of the amino acids.

Sufferers from beriberi, the deficiency disease of thiamine, complain of numbness in the legs, pain in the calf muscles and exhaustion. Paralysis ultimately becomes marked, the individual has difficulty in breathing, and a specific type of heart trouble develops. This is known as "beriberi heart." It is characterized by an enlarged heart, a decreased circulation time and elevated or normal venous pressure. Upon administration of vitamin B<sub>1</sub>, recovery is rapid, if no therapy is given the patient dies. A characteristic wasting in the ends of certain nerves can be demonstrated at autopsy, a peripheral neuritis or peripheral neuratrophy.

It is recognized by most that the occurrence of beriberi in the United States is rare. It has been suggested that even mild thiamine deficiency is seldom found. However, this is not the case in other parts of the world. In 1947 beriberi was responsible for 24,000 lives in the Republic of the Philippines. This may be



Fig. 38—(a) Rat maintained in human diet & fed 100% Vitamin D<sub>3</sub> (the rat is deficient in Vitamin D<sub>3</sub>) and a very large tumor. (b) Rat 7 weeks after receiving Cerelexin (a Vitamin D<sub>3</sub> analog) in the diet. Attention is called to greatly improved dermatitis and tumor. (c) Rat 7 weeks after receiving Cerelexin has restored the animal to a normal healthy condition. Observe the remarkable improvement in the tumor. The photograph was taken by Kalamazoo Mich.

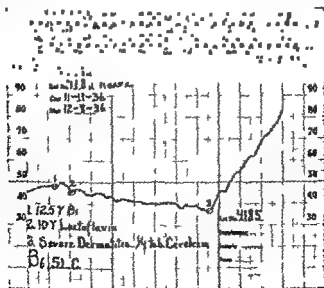


Fig. 39—Growth chart of rat shown in Fig. 38 (Courtesy The U.I. Company Kalamazoo Mich.)

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a



b



c

Fig 38—*a* Rat maintained on a diet in which crystalline flavin (i.e. rat is deficient in vitamin B<sub>2</sub>) for 12 weeks. *b* Rat after receiving Cerelexin (a vitamin B<sub>2</sub> supplement). *c* Rat after five weeks Cerelexin treatment. The rat is in normal condition. Observe the remarkable growth in the chart. (Courtesy The Upjohn Company, Kalamazoo, Mich.)

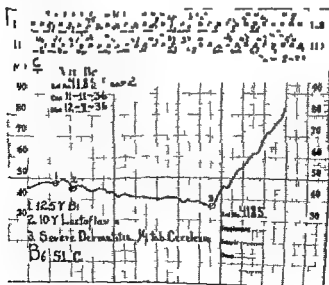


Fig 39—Growth chart of rat shown in Fig 38. (Courtesy The Upjohn Company, Kalamazoo, Mich.)

expressed in still another way in 1946, out of every 100 000 people approximately 170 died of tuberculosis and approximately 150 from beriberi (the first and second causes of death)

About that time the British experiment,' as it is frequently referred to was instigated. One of its objectives was to demonstrate that the incidence of beriberi might be appreciably re



Fig. 40.—Cantonese slave girl showing the result of vitamin B deficiency the atrophy and degeneration typical of nutritional neuritis. In beriberi (out right B deficiency) edema may or may not be present. Dry and wet forms exist. (From Talbot. Clinical Pediatrics. D Appleton Century Co. Inc.)



Fig 41—Lack of Vitamin B. These rats are from the same litter. The one on the left had enough vitamin B. The other received none. Notice the result on general health and growth as well as on muscular control (Courtesy Wisconsin Alumni Research Foundation)

duced by the use of enriched or fortified rice. In 1947 a survey of approximately 12% of the population revealed a high incidence of beriberi as determined by clinical examinations. For two years, one segment of the population was supplied with fortified rice. For one pound of rice 2 mg of B<sub>1</sub>, 15 mg of niacin and 13 mg of iron were added. The control area received the rice normally used by the people which was unfortified. During the experiment, the incidence of beriberi in the area which received fortified rice was reduced approximately 89%. There was no change in the control population. The enriched rice was acceptable, as it did not differ appreciably in flavor, or texture, from that to which the people of Bataan were accustomed.

The recommended allowances of thiamine are based upon the concept that a ratio exists between calories and thiamine throughout the entire caloric range. However, it is believed that as the caloric expenditure increases above the basal levels, the proportion of thiamine required decreases. Thus, the recommended allowances are based on 0.5 mg per 1,000 calories for energy needs less than 3,000 calories. It is thought that 0.2 mg for each additional 1,000 calories above the 3,000 calorie level may be sufficient. If the diet consists of less than 2,000 calories, less than 1 mg of thiamine is not recommended. It has been estimated that the minimum requirement for adults may be about 0.23 mg per 1,000 calories. However, it must be pointed out that requirements vary with different persons and with the amount of carbohydrate in the diet.

While rice is a major source of thiamine for many people in the world, since it might supply from 40 to 90% of the calories in their diet, no one food in the American diet may be regarded as a single important supply of thiamine. Vitamin B<sub>1</sub> from many foods must be combined to meet the daily requirements of thiamine. Yeast, wheat germ, whole grain cereals, enriched breads and cereal products, meats, glandular and muscle meats, nuts, milk, green vegetables, and fruits are all sources of thiamine. Concentrates are prepared from yeast, wheat germ, rice polishings, or liver.

Unlike the fat soluble vitamin A, thiamine is not stored to any extent in the animal body. Stress, such as febrile diseases, or

TABLE 27

RECOMMENDED DAILY DIETARY ALLOWANCES FOR THIAMINE  
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG (LB)	HEIGHT CM (IN)	THIAMINE MG
Men	25	65 (143)	170 (67)	1.6
	45	65 (143)	170 (67)	1.5
	65	65 (143)	170 (67)	1.3
Women	25	55 (121)	157 (62)	1.2
	45	55 (121)	157 (62)	1.1
	65	55 (121)	157 (62)	1.0
	Pregnant (3rd trimester)			1.5
	Lactating (850 ml daily)			1.5
Infants*	0-1/12*			
	1/12-3/12	8 (13)	60 (24)	0.3
	4/12-9/12	9 (20)	70 (28)	0.4
	10/12-1	10 (22)	75 (30)	0.5
Children	1-3	12 (27)	87 (34)	0.6
	4-6	18 (40)	109 (43)	0.8
	7-9	27 (59)	129 (51)	1.0
Boys	10-12	35 (78)	144 (57)	1.3
	13-15	49 (108)	163 (64)	1.6
	16-20	63 (139)	175 (60)	1.9
Girls*	10-12	36 (79)	144 (57)	1.2
	13-15	49 (108)	160 (63)	1.3
	16-20	54 (120)	162 (64)	1.2

\*See Table 3 for explanatory footnote

TABLE 28

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 1.2 MG OF THIAMINE

FOOD	APPROXIMATE AMOUNT
Whole wheat bread	17 slices
Enriched white bread (2% nonfat milk solids)	20 slices
Oatmeal, cooked	5½ cups
Beef, round, without bone	60 ounces (3¾ pound)
Pork, loin or chops, without bone	4 ounces
Liver, beef, fried	16 ounces (1 pound)
Milk, whole	13¼ cups (3¼ quarts)
Egg, medium, raw	24 (2 dozen)
Kale, cooked	15 cups
Split peas dry	¾ cup

Adapted from Composition of Foods Raw Processed Prepared U S Department of Agriculture Handbook No 8



surgery may rapidly deplete the small thiamine reserves, hence it is necessary to include thiamine regularly in the diet in order to prevent deficiencies

### Vitamin B<sub>2</sub>—Riboflavin, C<sub>17</sub>H<sub>20</sub>N<sub>4</sub>O<sub>6</sub>

Some of the early history relating to the discovery of vitamin B<sub>2</sub> is discussed at the beginning of this chapter. However, it is of interest to note that riboflavin was recognized as early as 1879 as a pigment in whey. In 1935 identification and synthesis of riboflavin was reported.



riboflavin deficiency in the diet. Below rat that received a micrograms of riboflavin weekly or cataract. The animals were perment at which time they Day Darby and Langston J

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A number of flavins (colored substances) occur in nature and all are identical. They are found in milk (lactoflavin), egg (ovo flavin), grass, liver, kidney, etc. The source names have been dropped in favor of the name riboflavin. This is a yellowish green fluorescent substance, heat stable but labile in alkali or upon exposure to light. Like the rest of the vitamin B complex, riboflavin is water soluble. Practical studies in cooking indicate that it is little affected by home stewing methods of meat cooking, but there are appreciable losses when meats are roasted or fried. About 5 to 20% loss occurs in the canning process. There is some loss in riboflavin content in milk during the process of

pasteurization and irradiation. Of more direct interest, however, is the fact that loss may be as high as 75% after the milk has been bottled and exposed to direct sunlight for three and one-half hours. Thus, the homemaker should take proper precautions to insure adequate protection of milk bottles from light.

It is also known as vitamin G. Riboflavin is of interest because it provides another link between vitamins and enzymes. It, too, is involved in the metabolism and breakdown of carbohydrate.



A

B

Fig. 43—Cheilosis responds to treatment. A child 6 years old with typical lesions of ariboflavinosis involving the upper and lower lips but not extending to the buccal mucosa. Other typical manifestations of riboflavin deficiency include photophobia, dimness of vision and superficial keratitis. At right is the patient after a period of vitamin therapy. The lesions in this case were obviously the result of ariboflavinosis. Investigation indicated that the family of which the child was a member subsisted principally on starchy foods, namely macaroni and potato, with fruits and vegetables being eaten only occasionally. Meat was served once weekly and a quart of milk was apportioned daily among six. B After treatment with riboflavin. (Reproduced from Therapeutic Notes Parke Davis & Co. through the courtesy of Dr. William P. Shields and the New England Journal of Medicine.)

A clear cut human deficiency disease (ariboflavinosis) is not described, but a number of symptoms arise from lack of riboflavin. Lack of riboflavin may be associated with cataract. In

conjunction with vitamin A, riboflavin probably is needed for the regeneration of the visual purple (rhodopsin) of the retina of the eye. Conjunctivitis, lacrimation, burning of the eyes, photophobia, and dimness of vision also occur.

A characteristic dermatitis about the nose and mouth of human beings also results from lack of this vitamin. The occurrence of comedones, giving a "shark skin" appearance to the region of the nose and eyes, is suggestive of riboflavin deficiency. Lesions appear at the angles of the mouth (cheilosis), fine scaly desquamation in the nasolabial folds, in the vestibule of the nose, around the eyes, and on the ears. The lips are reddened and denuded, and a glossitis appears.

It has been shown that clinical manifestations of a riboflavin deficiency may occur in man when the intake is less than 0.6 mg daily. Lack of overt deficiency signs, such as characteristic lesions, does not necessarily mean an adequate intake of ribo-

TABLE 29

RECOMMENDED DAILY DIETARY ALLOWANCES FOR RIBOFLAVIN  
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG (LB)	HEIGHT CM. (IN.)	RIBOFLAVIN MG
Men	25	65 (143)	170 (67)	1.6
	45	65 (143)	170 (67)	1.6
	65	65 (143)	170 (67)	1.6
Women	25	55 (121)	157 (62)	1.4
	45	55 (121)	157 (62)	1.4
	65	55 (121)	157 (62)	1.4
	Pregnant (3rd trimester)			2.0
	Lactating (850 ml daily)			1.5
Infants	0 1/12*			
	1/12 3/12	6 (13)	60 (24)	0.4
	4/12 9/12	9 (20)	70 (28)	0.7
	10/12 1	10 (22)	75 (30)	0.9
Children	1 3	12 (27)	87 (34)	1.0
	4 6	18 (40)	109 (43)	1.2
	7 9	27 (59)	129 (51)	1.5
Boys	10 12	35 (78)	144 (57)	1.8
	13 15	49 (108)	163 (64)	2.1
	16 20	63 (139)	175 (69)	2.5
Girls	10 12	36 (79)	144 (57)	1.8
	13 15	49 (108)	160 (63)	2.0
	16 20	54 (120)	162 (64)	1.9

\*See Table 3 for explanatory footnote

TABLE 30

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 14 MG. OF RIBOFLAVIN

FOOD	APPROXIMATE AMOUNT
Liver beef fried	1½ ounces
Milk whole	3½ cups
Kale cooked	5½ cups
Beef round without bone	22 ounces
Pork loin without bone	21 ounces
Egg medium raw	10 (each)
Bread enriched white nonfat milk solids	36 slices
Bread whole wheat	46 slices
Split peas dry	2¼ cups

Adapted from Composition of Foods Raw and Processed Prepared by the Department of Agriculture Handbook No. 8

flavin. The appearance of deficiency signs has been said to vary with the individual and with the degree of environmental stress. Thus on the basis of existing research it is believed that a minimum of 11 mg per day is needed to maintain tissue reserves. The daily recommended allowances for riboflavin may be found in Table 29.

Riboflavin is found in many foods. In addition some evidence has been advanced showing that this vitamin may be synthesized in the intestinal tract. Some riboflavin from this source may be available to the body. However it is customary to consider foods as the source of B<sub>2</sub>. Liver kidney milk yeast wheat germ muscle meat egg and leafy green vegetables are the main sources of riboflavin. Other sources contribute little.

### Niacin (Nicotinic Acid), C<sub>6</sub>H<sub>5</sub>O<sub>2</sub>N

The background of our present knowledge of the vitamins already makes fascinating reading and this is particularly true of nicotinic acid and its specific deficiency disease pellagra. Two hundred years ago this disease was described and attributed to faulty diet. At one time it was thought to be due to a poison developing in corn (maize) another theory was that corn contains a photosensitizing substance similar to that found in buckwheat which when acted upon by sunlight produced characteristic skin changes in pellagra. Neither theory has any proof except the coincidence of the pellagra prevalence in some corn eating sections. The word pellagra means rough or inflamed skin. Spies suggests that pellagra should not be considered a disease of the skin but a systemic disturbance.

To Goldberger (1913) is due the credit for establishing the pellagra as a deficiency disease which could be cured by the administration of brewer's yeast. Later he found that an acid extract of yeast contained the P P (pellagra preventing) factor as did also certain other foods. Elvehjem (1937) later showed, by his experiments on dogs, that the nicotinic acid obtained from liver concentrates was curative for blacktongue in dogs (a syndrome similar to pellagra in man) and from that Spies and his workers, and Smith and his associates, using nicotinic acid, obtained dramatic cures of pellagra. Recently, Spies and his co-workers have suggested that both vitamins  $B_2$  and  $B_6$  aid in making the cures permanent.

Nicotinic acid is a white, crystalline, water soluble, heat stable alkali labile powder, having the formula  $C_6H_5O_2N$ . Nicotinic acid was prepared in pure chemical form as early as 1867, but was not recognized as the pellagra preventing vitamin until 1937. It is produced by oxidizing nicotine, during which process the toxic effect of the nicotine is destroyed and the vitamin is formed. It is the most stable member of the B complex.

One of the most important functions of niacin, apart from its pellagra preventing action, is its participation as components of coenzyme I and coenzyme II. These are concerned with glycolysis and respiration. Thus as indicated by Sherman, niacin along with thiamine and riboflavin is thought to be concerned with the intermediary and oxidation reduction metabolism.

The symptoms resulting from its lack (pellagra) are trembling of the head, burning pains in the mouth, vesicles on the lips, coated tongue, weakness, loss of appetite, gastrointestinal upsets, and typical skin lesions on the backs of the hands, the dorsal aspects of the feet, and around the neck and ankles.

Mild mental disturbances frequently are first to appear—confusion, dizziness, poor memory, and depression. Later the symptoms become more violent and hallucinations and delusions of persecution appear. The symptoms have been described as the 4 D's: dementia, diarrhea, dermatitis, and death.

Recent studies indicate that the entire picture is not yet clear. There seems to be a definite relationship between the incidence of pellagra and the amount of corn found in the diet. Not only is this due to the fact that when the greater part of the diet is

TABLE 31

RECOMMENDED DAILY DIETARY ALLOWANCES FOR NIACIN  
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YE.	WEIGHT KG (LB)	HEIGHT CM (IN)	NIACIN MG
Men	25	65 (143)	170 (67)	16
	45	65 (143)	170 (67)	15
	65	65 (143)	170 (67)	13
Women	25	55 (121)	157 (62)	12
	45	55 (121)	157 (62)	11
	65	55 (121)	157 (62)	10
	Pregnant (3rd trimester)			15
	Lactating (850 ml daily)			15
Infants	0 1/12*			
	1/12 3/12	6 (13)	60 (24)	3
	4/12 9/12	9 (20)	70 (28)	4
	10/12 1	10 (22)	75 (30)	5
Children	1 3	12 (27)	87 (34)	6
	4 6	18 (40)	109 (43)	8
	7 9	27 (59)	129 (51)	10
Boys	10 12	35 (78)	144 (57)	13
	13 15	49 (108)	163 (64)	16
	16 20	63 (139)	175 (69)	19
Girls	10 12	36 (79)	144 (57)	12
	13 15	49 (108)	160 (63)	13
	16 20	54 (120)	162 (64)	12

\*See Table 3 for explanatory footnote

TABLE 32

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 12 MG OF NIACIN

FOODS	APPROXIMATE AMOUNTS
Liver, beef, fried	3 ounces
Bran (breakfast cereal, almost wholly bran)	1 cup
Beef, round, without bone	7½ ounces
Pork, loin, without bone	18 ounces
Bread, enriched white, 2% nonfat milk solids	60 slices
Bread, whole wheat	17 slices
Milk, whole	40 cups
Potato, baked	3 pounds
Split peas, dry	2 cups
Peanuts, salted, roasted	½ cup

Adapted from Composition of Foods Raw Processed Prepared U S Department of Agriculture Handbook No 8

It has been suggested that pyridoxine or an associated form is concerned with the utilization of the unsaturated fatty acids—and the amino acid tyrosine

TABLE III  
PYRIDOXINE CONTENT OF FOODS\*

	MG PER 100 GM
Yeast, brewer's	2.47
Yeast, Fleischmann's	3.95
Yeast extract	1.03
Wheat germ	1.03
Skim milk powder	0.38
Whole milk	1.25
Quaker rolled oats	0.25
Split peas	0.40
Leg of lamb	0.45
Beef liver	0.81
Liver powder (Wilson)	1.45
Nutab (rice bran concentrate)	5.17

\*These figures are taken from unpublished assays provided by Dr. C. A. Elvehjem and reproduced from *Nutritional and Vitamin Therapy in General Practice* by Edgar S. Gordon with permission of The Year Book Publishers

According to Spies, the deficiency symptoms are extreme nervousness, irritability, abdominal pain, weakness, and difficulty in walking. Pyridoxine presumably is essential for hemoglobin formation although just how is not known.

Although the need for vitamin B<sub>6</sub> is generally accepted, it is difficult to establish a minimum requirement. Intestinal synthesis is believed to contribute a considerable proportion of the total amount needed. However, it has been suggested that the requirement may be similar to that for thiamine, namely, about 15 to 2 mg daily. With adequate intake of the potent whole grain cereals, legumes, seeds, and seed oils (corn, cottonseed), liver, kidney and cane molasses, body requirements are undoubtedly met. Fish liver oils are good sources, meats fair, and fruits and vegetables poor sources.

### Pantothenic Acid, C<sub>8</sub>H<sub>17</sub>NO<sub>5</sub>

Pantothenic acid, formerly known as "filtrate factor," was originally discovered as a "yeast growth factor." Now it is known also to be essential for animal well-being. Among the effects attributed to deficiency of pantothenic acid in animals are emaciation, loss of and graying of hair, ulcers in the intestinal tract, adrenal, kidney and cardiac damage, tissue dehydration,

and nerve degeneration, which results in a "goose step" gait. In fact, every tissue in the body seems to be affected by pantothenic acid deficiency. The word itself means "everywhere."

Human deficiencies are not yet clearly pictured. It is probable, however, that pantothenic acid is essential for human nutrition and that in some way its action is associated with riboflavin. The possibility of a relationship between human adrenal insufficiency and pantothenic acid deficiency is worth further study, as is its role in maintaining the integrity of nervous tissue. In

TABLE 31

DISTRIBUTION OF PANTOTHENIC ACID IN FISH FOODS IN MICROGRAMS PER GRAM

Liver	40
Egg yolk	63
Eggs	27
Broccoli	14
Peanut meal	53
Buttermilk, churned	46
Sweet potatoes	11
Lean beef	10
Beef liver	66
Pork liver	55
Beef heart	22
Pork loin	19
Leg of lamb	13
Skim milk	36
Squash	3
Canned salmon	7
Irish potatoes	65
Wheat bran	24
Canned pumpkin	4
Whole milk	28
Rice bran	22
Split peas	21
Tomatoes	1
Soybean meal	14
Carrots	1
Rolled oats	11
Wheat	11
Barley	10
Spinach	12
Onion	12
Yellow corn	8
English walnuts	8
Oranges	07
Polished rice	4
Banana	07
Prunes	06
Raisins	06
Almonds	03

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animal experimentation, pantothenic acid has been shown to be involved in many reactions, as well as in interrelationships with other nutrients

Pantothenic acid is fairly stable to moist heat especially at a neutral pH, but it is destroyed by prolonged dry heat. Studies as to loss during cooking are meager, however, the loss is probably of similar magnitude to that of thiamine since its solubility and stability are similar.

Pantothenic acid is widely distributed in foods. Liver is one of the richest natural sources. Meat, cereals, yeast, egg yolk, peanuts, and milk are good sources. In the process of milling grains into flour, only about one half of the pantothenic acid is lost, contrary to the losses of other members of the B group.

The requirement levels are not yet known, but one sees speculative suggestions that the daily requirement for the normal adult is from 5 to 10 mg. Elvehjem, however, computes that the probable requirement may be around 5 mg a day or the amount in 100 gm of liver. It has been estimated that the amount of pantothenic acid found in a well balanced diet of 2,500 calories is approximately 10 mg.

### Choline, $C_5H_{13}O_2N$

Choline has been known for many years to be a component part of the phospholipid lecithin, but not until about 1932 was its importance in nutrition demonstrated. At that time, it was shown by Best to be related to the mobilization of fatty acids in the body. With choline deficiency, liver fat rapidly accumulates. It is reported to be indispensable for lactation in adult rats and to prevent paralysis in suckling rats. The usual depression of growth rate occurs with its absence. It prevents hemorrhagic kidney degeneration in young rats and perosis (slipped tendon) in chicks and turkeys. Recent studies seem to indicate that choline takes part in the process known as transmethylation, the transfer of methyl groups from one compound to another. Thus it may be an integral part in protein metabolism.

A choline requirement has not been established. However, it has been estimated that the choline content of the average diet may be from 250 to 600 mg daily. Inasmuch as lecithin contains choline, meats, cereals, vegetables, and eggs become good sources of choline.

### Para aminobenzoic Acid, $\text{H}_2\text{NO}_2$

Para aminobenzoic acid also designated sometimes as PAB and PABA is a simple derivative of benzoic acid has been known to the chemists for years but not until 1941 was it shown to have vitamin like activity. It was first recognized through its effect on bacterial growth. Positive and negative experimental evidence has been presented indicating that graying of the fur of



Fig. 45.—The rat on the left whose hair as originally black shows gray ing of the hair as the result of a diet deficient in the anti gray hair factor. Its litter mate on the right received a normal diet. (Reproduced from Therapeutic Notes courtesy of Parke, Davis & Co.)

rats can be produced and cured by the para aminobenzoic acid level of the diet. It has been reported to be involved in normal pregnancy and lactation in addition to the other B vitamins. The antagonistic action between para aminobenzoic acid and the bactericidal effects of sulfanilamide (and the related drugs) is of current interest. The finding that para aminobenzoic was capable of reversing or preventing the bactericidal action of the

sulfonamides was the beginning of the antivitamin theory. It appears to be a competitive struggle between two structurally similar compounds for the same role. Clear-cut experimental data are lacking as to the role of para-aminobenzoic acid in human nutrition, that is, the requirement and distribution

### Biotin, $C_{10}H_{16}O_3N_2S$

Biotin has been recognized for some time as a dietary essential for microorganisms, but its importance to the animal body has only recently been appreciated. Its formula was determined



Fig. 46—Biotin deficiency (egg white injury) This animal, aged 85 days has received a diet containing 35% uncooked egg white since the age of 21 days and exhibits typical, acute exfoliative, desquamative (seborrheic) dermatitis, accompanied by loss of hair. The dermatitis is particularly severe about the head, flanks and forefeet. (Courtesy Research Laboratories of the M. M. A. Corporation Chagrin Falls, Ohio.)

by du Vigneaud in 1942. It has also been known for many years that characteristic symptoms developed in rats fed on diets containing large amounts of raw egg white. These symptoms include dermatitis, especially involving the feet, spectacled eyes and a progressive alopecia, poor feathering (in chicks), slow growth, and a curious paralytic condition. Experimental studies revealed the fact that an albumin—avidin—active in raw egg

white combines with the biotin of the egg white in such a manner as to render it inactive. A deficiency is thereby produced. The factor thus inactivated was formerly called vitamin H. Biotin and vitamin H are now known to be identical. Recent investigations have indicated that biotin functions in intermediary metabolism as part of the coenzyme system which acts in carbon dioxide fixation processes.

Human studies, of course, will be forthcoming as biotin has now become commercially available. One study was reported in which experimentally induced human biotin deficiency resulted in dry, peeling skin with a pronounced grayish pallor, muscle pains, lack of appetite, nausea, distress around the heart, and after the fifth week the mild depression progressed to extreme lassitude, somnolence and in two subjects out of the four, a mild state of panic. All symptoms cleared within four days after biotin medication was begun. Biotin may be supplied to the animal in part through intestinal synthesis. In addition, liver, kidney, yeast and egg yolk are the chief food sources.

### Inositol, $C_6H_{12}O_6$

Inositol was first isolated from meat in 1850 but its role as a possible vitamin was not recognized until 1940. The suggestion that it is a member of the B group is strengthened by the fact that it as the other members of the group is universally present in living matter although its distribution is more erratic and it appears in greater abundance. Inositol is a crystalline substance with a sweet taste. The phytin phosphorus of cereals has been found to be inositol hexaphosphoric acid.

A definite relationship appears to exist between inositol and pantothenic acid. Even when an adequate amount of inositol is present in the diet it is not absorbed in the absence of pantothenic acid. Inositol has been shown to cure mouse alopecia and spectacled eyes and to affect growth. The curative action and growth effect in some way appear related to the type and amount of fat in the diet. Reports indicate it to be required by the lactating rat. When injected into dogs, it accelerates intestinal motility. Its significance in human nutrition is not known. However, it is believed to be a factor in stimulating gastrointestinal motility and to be involved in fat metabolism.

## THE NUTRIENTS

Spleen, heart, kidney, brain, thyroid, and testes are found to have an especially high content of inositol. Large amounts are found distributed in the plant kingdom in the form of phytin (the calcium magnesium salt of inositol hexaphosphoric acid). No suggestion of requirement has been made.

## Folacin

Folacin refers to one of the newer members of the B complex. It is also called folic acid by which it was universally known until the name folacin was adopted by the American Institute of Nutrition in 1949. It is also referred to as the "pteryoglutamates". It is believed that there are at least three chemically related compounds which may be grouped together under the name of folacin.

Its synthesis in 1945 clarified reports on various postulated members of the B complex. There had been reports for a period of ten years on vitamins which were concerned with blood formation and growth in various animals. Vitamin M was essential for monkeys, factor U necessary for chicks, another deficiency condition in chicks was labeled as due to a deficiency of B<sub>12</sub>. In bacteriological studies, need of a growth factor was found—a factor given the name of *Lactobacillus casei* factor, one *Streptococcus lactis* R—and another potent factor which was called folic acid due to its abundance in leafy green plants. This factor was later found to occur in liver, kidney, yeast, and mushrooms. These independent studies were drawn together by the final isolation and synthesis of folic acid. This folic acid seemed to be the effective agent in each of the studies. So folic acid was accepted as the common vitamin.

Due to its relationship to experimental macrocytic anemia folacin was immediately hailed as the curative factor. Research has found it to be effective therapeutically in the macrocytic anemias of pregnancy, infancy, in nutritional macrocytic anemia and in sprue. However, when used as a treatment in pernicious anemia it was found neither to prevent nor to alleviate the neurological symptoms. Investigators have found that folacin may be related to the metabolism of tyrosine, an amino acid. In some laboratory animals folacin seems to be important in the reproductive processes.

Although folic acid has been effective in the clinical treatment of several macrocytic anemias, it does not follow that a deficiency disease exists. To date, a human requirement for the vitamin has not been established. It is recognized that it is essential to human nutrition. The National Research Council suggests\* that it seems probable that dietary intakes of the order of less than 1 mg per day can be expected to cover any nutritional needs for folic acid activity.

Folic acid is present in all animal tissues and is released by autolysis, a fact which suggests that it has functional activity. The exact distribution in foodstuffs is incomplete, but it is known that fresh green leafy vegetables and organ meats are rich sources. Additional good sources are lean beef, veal, wheat cereals, and root vegetables. It is present in other foods, but in smaller amounts.

### Vitamin B<sub>12</sub>

Vitamin B<sub>12</sub> is the youngest officially recognized member of the B group. It was isolated by painstaking fractionation of liver in an effort to find what fraction of liver was responsible for its antipernicious anemic action. Formerly, the amount of liver needed to control a patient with pernicious anemia was roughly 400 gm daily—nearly one pound.

In 1948 Rickes, Brink, Komuszy, Wood, and Folkers in the United States and Smith and Parker in England were effective in the isolation of vitamin B<sub>12</sub>. It is a red substance which contains cobalt and phosphorus. There is still much to be discovered about the chemistry of this vitamin.

Once vitamin B<sub>12</sub> was found to be effective in the treatment of pernicious anemia, interest was directed toward identifying its place in the intrinsic extrinsic factor scheme as postulated by Castle (see Chapter 40). The belief is accepted by many that vitamin B<sub>12</sub> is part, if not all, of the *extrinsic factor*. The function of the *intrinsic factor* seems to be to insure the absorption of vitamin B<sub>12</sub>. This does not preclude the possibility of there being other currently unknown functions of the *intrinsic factor*. Recent research has indicated that pernicious anemia patients lack the *intrinsic factor* and therefore fail to absorb vitamin B<sub>12</sub>. It is interesting to note that extremely small dosages of

\*Bulletin No. 302, p. 26

vitamin B<sub>12</sub>, approximately 1 microgram daily, parenterally, will allow replacement of the insufficiency in the patient with pernicious anemia.

Investigations have been made to determine if vitamin B<sub>1</sub> is involved in other reactions. Some studies have reported that the vitamin may stimulate growth in children. Others have failed to demonstrate similar effects. Some evidence suggests that vitamin B<sub>1</sub> may be associated with the metabolism of methionine, one of the essential amino acids.

The data concerning the distribution of vitamin B<sub>12</sub> in foods are incomplete. The richest food sources so far seem to be liver, kidneys, eggs, milk, and muscle meats. Future research will contribute to the existing knowledge of the functions, requirement, and sources of vitamin B<sub>12</sub>, however, in a few short years its importance in human nutrition has been established.

### The Citrovorum Factor

Folic acid and vitamin B<sub>12</sub> cannot be discussed without some mention being made of the citrovorum factor. This factor is closely related both chemically and functionally to folic acid. It is believed that the citrovorum factor is formed from folic acid within the body. There is considerable evidence that this reaction takes place and that the citrovorum factor is as effective clinically and for the same conditions as folic acid. However, so far, the citrovorum factor has not been as effective with pernicious anemia patients as vitamin B<sub>12</sub>.

### Vitamin P

In 1936 Szent Gyorgyi and his co-workers postulated the existence of a new vitamin in lemon peel which they called vitamin P, designating capillary permeability. Szent Gyorgyi believed vitamin P to be either a mixture of the flavone glucosides hesperidin and eriodictyol. The reports of usage of this product have been contradictory. However in 1942, hesperidin chalcone (C<sub>22</sub>H<sub>26</sub>O<sub>12</sub>) was isolated from lemon peel. This substance is believed to be the pure form of Szent Gyorgyi's vitamin P. Preliminary experiments with this material have shown that it does exert beneficial effect upon the state of the capillaries decreasing the fragility and preventing localized hemorrhages.

Lemon is a rich source of this vitamin. A single lemon—juiced, the peel minced, covered with water, and boiled for 10 minutes in a glass container, and the strained liquid added to the lemon juice—has a yield of approximately 150 mg. of vitamin P.

### Rutin

More recently another flavone derivative glucoside has been found in tobacco leaves and buckwheat. It is reported to have physiological activity similar to vitamin P. It is available for clinical use and is under such investigation. The potential value of both of these vitamins is apparent if the final evidence is conclusive in the protection of the vascular system in conditions of high blood pressure.

### Miscellaneous Postulated Vitamins

There are other vitamins for which there is as yet no definite proof and which to date have no relation to human nutrition. It can be assumed that if the diet is well balanced and the known vitamins are supplied, the possible obscure vitamins will likewise be present. It is because of the interrelation between the various known vitamins and the additional vitamins found from time to time in food products that it is important to obtain our vitamins from natural sources rather than in commercial form (synthetic vitamins). An exception to this rule will of course be necessary when vitamin intake must be larger than can be supplied by dietary adjustment without raising the intake of certain foods to a level which will result in a compensatory decrease in other essential foods. Such a condition may arise and may conceivably produce other deficiencies.

Among these additional vitamins are

Grass juice factor—found in summer milk and in green grass which promoted growth of rats and guinea pigs

Vitamins  $B_{12}$  and I—lactation factors

Factor W—a growth factor for rats, chicks and dogs

Factors R and S—dog growth factors for chicks

The anti-graying factor (anti-ichthyomitrin factor)—both para-aminobenzoic and protothemic acids have been suggested

Factor I—factor protective against pneumonia

A new dietary factor for guinea pigs—found in cream



## The Effect of Cooking Upon Water Soluble Vitamins

Since vegetables are considered one of the major sources of vitamins and minerals in the diet, considerable interest has been shown concerning the effect of cooking upon the nutritive content of foods. One of the most comprehensive studies is that reported by Kiehl and Winters.\*

In this experiment, twelve vegetables were selected: asparagus, beets, broccoli, cabbage, carrots, cauliflower, sweet corn (yellow), green beans, peas, potatoes, summer squash, and spinach. A uniform portion of each vegetable (family sized quantities) was cooked to a prescribed degree of doneness by the following methods: (1) pressure cooked with  $\frac{1}{2}$  cup water added, (2) with sufficient water added just to cover the vegetable, (3) with  $\frac{1}{2}$  cup more water than that described in (2) and (4) with no added water, or the "waterless" method. After cooking the vegetables were analyzed for the content of the following vitamins and minerals: calcium, iron, phosphorus, thiamine, riboflavin, niacin, ascorbic acid and carotene.

The specific results are, of course, too detailed to reproduce here. However, the investigators made some general conclusions and observations. The greatest loss of both vitamins and minerals occurred as a result of cooking by the "old fashioned" method of water to cover (method 3). The smallest loss was found in those vegetables prepared by the "new" or waterless method (method 4). Vegetables cooked by the other two methods were similar in results and were intermediate between 3 and 4 in vitamin and mineral retention. It must be pointed out that there were variations among individual vegetables. Losses of ascorbic acid were the greatest in all methods of cooking.

The investigators concluded that of the two factors which affect vitamin and mineral losses in cooking, the leaching effect of cooking water and the influence of oxidation, the leaching out of the vitamins and minerals constituted the most serious source of loss in this study. A review of the original report is suggested for an accurate understanding of the effect of the variations in the cooking methods.

In general it was found that the retention of minerals was better than that of vitamins.

\*Kiehl, W. A. and Winters, R. W. Effect of Cooking Methods on Retention of Vitamins and Minerals in Vegetables. J. Am. Diet. A. 46: 966-9. 1950.

TABLE 35

## THE DIETETIC WATER-SOLUBLE VITAMINS—THEIR FUNCTIONS AND IMPORTANT SOURCES

VITAMINS	FUNCTION	DEFICIENCY SYMPTOMS	PRIMARY SOURCES
Ascorbic acid (vitamin C)	Essential for growth Essential for formation of intercellular cement Aids in prevention of capillary fragility Aids in wound healing	Scurvy (deficiency disease) Tendency to bruise easily Sore gums Hemorrhages around bones	Citrus fruits Green leafy vegetables Strawberries Cantaloupe Tomatoes Apples Potatoes
Thiamine (vitamin B <sub>1</sub> )	Essential for growth Essential for carbohydrate metabolism Essential for normal functioning of nerves Aids normal digestion	Beriberi (deficiency disease) Retarded growth Nerve disorders Loss of appetite	Pork Whole grain breads and cereals Enriched breads and cereals Beans dry kidney or Lima Peas split Soybeans Liver
Riboflavin (vitamin B <sub>2</sub> )	Essential for growth Essential for carbohydrate metabolism Essential for health of skin Essential for normal functioning of eyes	Retarded growth Lesions at corners of mouth (cheilosis) Cataract like symptoms and dimness of vision Inflammation of the tongue	Milk Liver Green leafy vegetables Meats—fowl Whole grain breads and cereals Enriched breads and cereals
Niacin	Essential for growth Essential for carbohydrate metabolism Essential for normal functioning of digestive tract Essential for health of skin Essential for normal functioning of nervous system	Retarded growth Pellagra (deficiency disease) Glossitis (smooth tongue) Digestive disorders Mental disturbances Skin disorders	Liver Lean meats Legumes peas and beans Whole grain breads and cereals Enriched breads and cereals Peanuts

Other investigations have suggested that the method of cooking is important in the retention of vitamin and mineral value in food. Those professionally interested in nutrition continually emphasize the dangers inherent in using improper cooking methods.

### Review Questions

- 1 What is the chemical name for vitamin C?
- 2 What is the deficiency disease of vitamin C?
- 3 What subclinical symptoms may result from an inadequate supply of this vitamin?
- 4 What are the most important sources of vitamin C?
- 5 What is the chemical name of vitamin B<sub>1</sub>?
- 6 What is the deficiency disease of this vitamin?
- 7 What foods are good sources of vitamin B<sub>1</sub>?
- 8 What is the chemical name of vitamin B<sub>2</sub>?
- 9 What are good sources of this vitamin?
- 10 With which specific disease is niacin associated?
- 11 Which vitamin is associated with the treatment of pernicious anemia?
- 12 Name additional fractions of the B complex. How are they related to human nutrition? What is known of their reaction in experimental animals?

### Suggested Projects

- 1 Examine your own menus. Calculate the thiamine, riboflavin, and niacin found in your foods for one day. How does your intake of these vitamins compare with the recommended allowance? If any of these vitamins are below the recommended allowance, how may you increase your diet so as to obtain adequate amounts? Are your suggestions practicable within your pattern of living?
- 2 Calculate a 1,200 calorie diet for a weight loss regimen. Calculate the thiamine, riboflavin, and niacin found in the menus planned. Do they meet the recommended allowances for the 25 year old woman? If not, how can you adjust the diet, still keeping within the 1,200 calories, and meet other nutritive needs?
- 3 Examine your own menus and the calculations obtained in review project No. 1. What percentage of your thiamine, riboflavin, and niacin was supplied by enriched products? Would your intake meet recommended allowances without enrichment?
- 4 Assume you were allergic to milk and milk products. Would your menus meet the recommended allowances for thiamine, riboflavin and niacin if this food were omitted in all forms? If not, how could you adjust the menus to obtain adequate amounts of these nutrients?
- 5 Plan a menu for a 16 year old girl. Can you easily obtain the recommended allowances of thiamine, riboflavin, and niacin within the food pattern followed by most teenagers? If not, how might you suggest to her that she modify her menus? Do you think that she would accept your ideas?

## CHAPTER 13 MINERALS AND MINERAL METABOLISM

Many minerals and trace elements are believed necessary in normal human nutrition. Deficiencies of a few have been observed, however, it is not known if inadequate dietary intake is always the sole factor in producing a deficiency. Complex interrelationships among minerals, vitamins and organic substances have been noted. There is wide variation regarding the requirement and utilization of minerals. In most cases the need will vary with the age and sex of the individual. While some significant information is available concerning metabolism of minerals, much remains to be discovered.

Minerals, the inorganic constituents of the diet, function in at least three ways. They are constituents of teeth and bone and as such give rigidity and relative permanence to the structures. They are constituents of all soft tissue. Held in solution in the body fluids, they influence the irritability of muscle and nerve and maintain the neutrality, osmotic pressure and solvent power of these liquids. They yield no energy and frequently are excreted unchanged. The minerals are occasionally ingested in free form as sodium chloride ( $\text{NaCl}$ —table salt) but in general they are combined with organic substances.

While all the minerals are equally important, just as every element which is part of the structure of the cell is essential to life, specific attention need be given only to the inclusion of certain minerals in the diet; the others may be assumed to be supplied adequately in the average daily food.

The only minerals requiring special calculation in the diet are calcium (Ca), phosphorus (P) and iron (Fe) except when due to disease condition other mineral constituents of the diet may need adjustment (see section on Modifications of the Normal Diet).

Calcium, sometimes spoken of as an alkaline earth metal, has many important functions within the body. It is present in larger amounts than any other mineral. Approximately 99% of the calcium is involved in the construction and function of the

bones and teeth. It is also necessary for the normal clotting of blood (see Chapter II, Vitamin K), and for the normal contractibility of muscles. The alternate contractions and relaxations of the heart muscle are dependent upon the presence of calcium, sodium, and potassium in the fluid which bathes the heart. The blood calcium level is controlled by the parathyroid gland, which is a tiny gland in the throat, associated with the thyroid. Removal of the parathyroid gland from animals, or a decrease in calcium of the blood from any other cause, results in an increased muscular irritability or tetany (muscle spasm or convulsion). An increase in calcium level results in the reverse effect, extreme lethargy. An increase in potassium (K) has an effect similar to a decrease in calcium, and a decrease in potassium has an effect similar to an increase in calcium. The action is antagonistic. Calcium is also concerned with nerve conduction and has been reported to have nonspinning qualities (see paragraph on Iron page 208).

On the basis of the information obtained from a number of dietary surveys, it is thought that calcium is the mineral most likely to be deficient in the human dietary. Because of the difficulty in diagnosing calcium deficiency clinically, there are no data to substantiate the evidence disclosed by surveys.

One of the most important considerations in a study of calcium in human nutrition is the amount of calcium that is absorbed from the diet and is therefore available to the individual. It is generally accepted that the ability to utilize the calcium in ingested foods will vary to a great extent among individuals. In human beings, usually no more than 20 to 30% is absorbed from the diet. It has been shown to be greater in children who were actually suffering from deficiency.

There are several factors which have been demonstrated to bring about optimum absorption of calcium from foods. Among those are (1) the pH of the gastrointestinal tract, calcium is favorably absorbed in the upper part of the small intestine while the pH is still acid, (2) the ratio of calcium and phosphorus in the diet, an optimum ratio for growth is 1:1 and 2:1 (approximately the ratio found in both human and cow's milk), lower ratios may be sufficient for optimum utilization in the adult, (3) a high protein diet favors calcium absorption, (4) an adequate supply of vitamin D aids calcium utilization, (5) some

materials form insoluble calcium salts in the gastrointestinal tract and thereby render the calcium unavailable. Some of these materials are oxalates, phosphorus and phytic acid (6) when there is impaired fat absorption and insoluble calcium soaps are formed calcium absorption is reduced. These are some of the factors which influence calcium absorption. Because of individual variation some will be important in calcium metabolism in one individual and unimportant in others. The recommended allowances (see Table 36) take these factors into account and include a margin of safety.<sup>1</sup>

TABLE 36

RECOMMENDED DAILY DIETARY ALLOWANCES FOR CALCIUM  
Food and Nutrition Board National Research Council Revised 1953

	AGE YR.	WEIGHT KG (LB)	HEIGHT CM (IN)	CALCIUM GM
Men	25	65 (143)	1 0 (67)	0.8
	45	65 (143)	1 0 (67)	0.8
	65	65 (143)	1 0 (67)	0.8
Women	25	55 (121)	1 5 (62)	0.8
	45	55 (121)	1 5 (62)	0.8
	65	55 (121)	1 5 (62)	0.8
	Pregnant (3rd trimester)			1.5
	Lactating 800 ml daily			2.0
Infants	0 1/12 <sup>100</sup>			
	1/12 3/12	6 (13)	60 (24)	0.6
	4/12 9/12	9 (20)	80 (31)	0.8
	10/12 1	10 (22)	95 (37)	1.0
Children	1 3	15 (33)	95 (37)	1.0
	4 6	18 (40)	105 (41)	1.0
	7 9	25 (55)	125 (50)	1.0
Boys	10 1	35 (77)	144 (57)	1.2
	13 15	49 (108)	163 (64)	1.4
	16 20	63 (139)	175 (69)	1.4
Girls	10 12	36 (79)	144 (57)	1.2
	13 15	49 (108)	160 (63)	1.3
	16 20	54 (119)	165 (65)	1.3

<sup>1</sup> See Table 3 for explanation of footnote

Milk is the richest source of calcium. Without the inclusion of at least one pint of milk daily there is usually inadequate intake of calcium. Fruits and vegetables, especially leafy vegetables, are relatively rich in calcium. Sherman states that experimental evidence would indicate that the calcium of cabbage

collards, kale, leeks, lettuce, rutabaga, leaves, and turnip tops is well utilized. The calcium of spinach, beet greens, and New Zealand spinach, however, is utilized very poorly, if at all. The difference is due to the oxalic content of the latter group which interferes with calcium utilization. Feeding experiments indicate that orange juice exerts a favorable effect on calcium retention out of proportion to the calcium which it contains. Meats and milled cereals are poor sources of this mineral. Table 37

TABLE 37  
AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 0.8 GM. CALCIUM

FOODS	APPROXIMATE AMOUNT
Milk	3 cups
Cottage cheese (from skim milk)	3 cups
Cheddar cheese, grated	1 cup
Egg, raw, whole	30 each
Liver, beef, fried	20 pounds
Beef, round, without bone	16½ pounds
Kale, cooked	3½ cups
Cauliflower, cooked	30 cups
Dried prunes, uncooked	160 large

part

shows the varied amount of foods fairly rich in calcium which will supply the recommended allowances of an adult woman.

During periods of growth, the calcium need is high, as indicated in Table 36. The need in adolescence is often neglected. Also, during pregnancy the calcium requirement is increased, and while lactating, it should be even higher. It is important for the health of both the baby and the mother that adequate amounts of calcium are supplied by food at this time.

Phosphorus is also a major constituent of the bones and teeth, approximately 80% of the amount in the body is found in the skeletal tissues. The remaining 20% is distributed in combination with proteins, lipids, carbohydrates, and in organic compounds. Phosphorus is a constituent of every living cell. The phosphates (salts of phosphorus), especially the sodium and potassium salts, are important factors in maintaining the neutrality of body fluids (see discussion of Acid Base Balance later in this chapter).

It has been said that compounds of phosphorus have a greater variety of function than any other nutrient. In addition to the

previously mentioned roles, they are involved in the metabolism of proteins, fats, and carbohydrates of muscles, nerve, and brain, and in vitamin and enzyme activity

As indicated previously, calcium and phosphorus are essential for bone and tooth structure. Approximately 85 per cent of the skeletal tissue is calcium phosphate. Vitamin D regulates the utilization of calcium and phosphorus and is, therefore, essential for normal bone tooth structure. The interrelation of calcium



Fig. 4.—Rats from the same litter 22 weeks old. The first rat did not have enough calcium. It weighed 91 gm. Note the short stubby body due to poorly formed bones. The second rat had an abundance of calcium and weighed 119 gm. Its bones are well formed. (Courtesy Bureau of Home Economics, United States Department of Agriculture.)



Fig. 4B.—Rats from the same litter 9 weeks old. The first rat did not have enough phosphorus and weighed only 60 gm. The second rat had an ample supply and weighed 115 gm. (Courtesy Bureau of Home Economics, United States Department of Agriculture.)

to phosphorus also is such that if either element is low, the other is not normally utilized, even though it be present in an adequate amount. When either of these minerals is lacking, such conditions may occur as stunting of growth, deformities, and rickets (a deficiency which can also result from inadequate amounts of vitamin D).

Concerning the allowance for phosphorus in the diet, the Food and Nutrition Board stated: "The evidence indicates that the



phosphorus allowances should be at least equal to those for calcium in the diets of children and of women during the latter part of pregnancy and during lactation. For other adults the phosphorus allowances should be approximately one and one half times those for calcium.

Phosphorus occurs in foods as a phosphoprotein in the casein of milk as a nucleoprotein in the ovovitellin of egg yolk as a phosphorized fat (phospholipid) lecithin and as phosphoric esters (salts) of carbohydrates etc. Milk is an important source of phosphorus (one quart contains 0.9 gm.) and meat, fish, fowl, egg, vegetables (especially the flowers and seeds), fruits, nuts and cereals contribute good amounts. It is generally believed that if the diet is adequate in calcium and protein the needs for phosphorus will be supplied.

Iron is the third mineral for which calculation is made in dietary studies or dietary adjustments. Even though only small amounts are required daily (the entire body contains not more than 3 to 4 gm.) that small amount is of tremendous importance.

Interest has centered around iron metabolism and while there are many gaps in the understanding some data are available. The small reserve is carefully conserved; only small amounts are excreted and the rest is largely salvaged and reused. This fact explains why a more widespread incidence of anemia does not exist. Iron deficiencies can occur and do when the need is increased without increased intake as in infancy when the liver reserve is gone and the dietary intake is not yet adequate in childhood where blood formation is going forward and as a result of menstrual losses, pregnancy or hemorrhage.

It is interesting to know that if calcium intake is abundant iron equilibrium may be established at a lower level. Calcium is said to exhibit a synergistic (supplementing or cooperating) action toward iron. Copper likewise exerts this synergistic action. Whipple and his associates conclude from their studies that a proper total mineral balance results in more effective utilization of iron.

When iron intake is inadequate or the body reserves are depleted a specific anemia results. Hemoglobin which gives blood its red color contains iron. It has the ability to form a loose

chemical combination with oxygen from the inspired air in the lungs, and thus it is carried to all tissues by the circulation. When iron is low, hemoglobin is low, tissue oxidation is below normal as a consequence, and weakness and depression ensue.

It is known that the individual can absorb ferrous iron more readily than ferric. Ferric iron is reduced in the human stomach to ferrous and it is then absorbed in the small intestine. Recently, it has been suggested that man can control the amount of iron absorbed. The regulation of iron absorption also has been shown to be dependent upon the needs of the body for iron, the amount being increased in animals and man deficient in iron.

The recommended allowances for iron for all ages are based upon information from present day research. In some instances, recommendations for a given age group have been suggested by the accepted needs of another age level. (See Table 38.)

TABLE 38

RECOMMENDED DAILY DIETARY ALLOWANCES FOR IRON  
Food and Nutrition Board, National Research Council, Revised 1953

	AGE yr	WEIGHT kg (lb)	HEIGHT cm (in)	IRON gm
Men	25	65 (144)	170 (67)	12
	45	65 (143)	170 (67)	12
	65	65 (143)	170 (67)	12
Women	25	55 (121)	157 (62)	12
	45	55 (121)	157 (62)	12
	65	55 (121)	157 (62)	12
	Pregnant (3rd trimester) Lactating (850 ml daily)			15 15
Infants	0-1/12*			
	1-1/12-3-1/12	6 (13)	60 (24)	■
	4-1/12-9-1/12	9 (20)	70 (28)	■
	10-12-1	10 (22)	75 (30)	6
Children	1-3	12 (27)	87 (34)	7
	4-6	18 (40)	109 (43)	8
	7-9	27 (59)	129 (51)	10
Boys	10-12	35 (78)	144 (57)	12
	13-15	49 (108)	163 (64)	15
	16-20	63 (139)	175 (69)	15
Girls	10-12	36 (79)	144 (57)	12
	13-15	49 (108)	160 (63)	15
	16-20	54 (120)	162 (64)	15

\*See Table 3 for explanatory footnote

The iron of milk is in a readily available form but is low in total content there being only 24 mg of iron per quart. This is only a fractional part of the day's requirement of the adult which is set at 12 mg by the Food and Nutrition Board of the National Research Council. To compensate for the low iron content of milk the young whose early diet is milk, are born with an extra supply of iron in the liver. The iron content of the baby's liver at birth is three times that of an adult, an amount which will supply enough iron for the first six months of life.

Certain foods notably liver, gizzard, kidney, apricots, peaches and prunes while rich in iron are effective out of proportion to their iron content in promoting blood regeneration in dogs made anemic by bleeding. Substances other than iron are present in these foods and give them added effectiveness. Today many cereal products such as bread, macaroni, rice and cereals are enriched with iron as well as with thiamine, riboflavin and niacin.

TABLE 39

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 12 MG OF IRON

FOODS	APPROXIMATE AMOUNT
Liver, beef, fried	5½ ounces
Beef, round, without bone	12 ounces
Pork loin without bone	14 ounces
Milk, whole	17 quarts
Egg, raw, whole	10 (each)
Molasses, medium	10 tablespoons
Kale, cooked	5 cups
Bread, white, enriched 2% nonfat milk solids	120 slices
Bread, whole wheat	24 slices
Oatmeal, cooked	7 cups
Split peas	1½ cups

Adapted from Composition of Foods, Raw and Processed, Prepared by U. S. Department of Agriculture Handbook No. 8

Iodine is necessary only in minute amounts, 0.002 to 0.004 mg daily for each kilogram of body weight. This small amount is however essential. Iodine is used in the manufacture of the secretion of the thyroid gland, thyroxine. With insufficient output of thyroxine there is decrease in metabolic rate since thyroxine stimulates the oxidative processes in the tissues. When insufficient iodine is ingested, enlargement of the thyroid gland (simple goiter) results (see Chapter 10).

Goiter is prevalent in specific areas called goiter belts where the iodine content of the environment is low. Sea water is rich

tively rich in iodine and therefore, as far as the salt spray can reach, or salt water seepage can go iodine is adequately supplied by vegetables grown in those regions. Due to variability in environmental conditions, the minute traces of iodine found in foods and the difficulty of analysis reliable data as to food content of iodine are not available. Excess iodine can be stored in the body for future use and experiments have proved that the administration of small amounts twice yearly for a period of two weeks to a month is good protection against goiter development. Iodized salt which contains one part either potassium or sodium iodide to 5 000 parts salt has had widespread use as a source of iodine. Such a product is used with safety to prevent simple goiter but for the overactive thyroid it might be dangerous. Iodine treatment of goiter should always be carried out under medical supervision. Goat's milk, fish and other salt water products have a fairly high content of iodine, 100 to 400 parts per billion of dry food. Vegetables grown in nongoitrous regions where iodine is a constituent of the soil are fair sources of the element.

**Sulfur** enters the body as the amino acids cystine and methionine components of the protein molecule. Approximately 1% of protein is sulfur therefore if protein intake is adequate the sulfur will likewise be adequate. Sulfur plays an important part in the oxidative process of the body through the medium of glutathione, a sulfur compound. Sulfur is a constituent of hair and nails. Insulin, the secretion of the pancreas which governs carbohydrate metabolism is a sulfur compound and vitamin B<sub>7</sub> or thiamine and biotin contain it. To a lesser extent sulfur is ingested as inorganic sulfate. Milk, whole grains, eggs, meat, pears and beans are good sources of sulfur.

**Sodium and potassium**, while important constituents require calculation to insure quantitative intake only in certain conditions such as Addison's disease and cardiovascular disturbances. Sodium and potassium are seldom lacking in food, in fact they are usually consumed in excessive amounts. Sodium is present in higher quantities in body fluids, potassium in the body tissues and in liquids secreted by glandular organs for instance milk. These two minerals are not interchangeable, in fact preponderance of either results in a disturbance in the water balance of the body. They function with calcium in regulating muscle

in irritability (See Appendix for data on the extent to which these minerals occur in foods also the discussion in Chapter 29 under Hypertension)

**Sodium chloride ( $\text{NaCl}$ )** is the largest constituent of mineral matter of the blood. Its presence is of utmost importance in regulating water balance. In an ordinary diet the average individual ingests from 10 to 15 gm daily in amount far in excess of his needs. Five grams is a liberal allowance unless sweating is profuse.

When  $\text{NaCl}$  elimination is retarded for any reason it follows that water will also be retained by the tissues in an effort to have the salt solution of the tissue fluids of proper concentration. This water retention has distinct disadvantages. It may therefore be necessary at times to limit the intake or to reduce it to a minimum. In such instances the salt may be reduced to 2 to 4 gm. Shohl suggests 4 gm is an approximate maintenance level. Reduction may be brought about by eliminating all salted foods using no salt except the small amount needed in the preparation of food avoiding salted butter, salted nuts, salted crackers etc. This is described in Chapter 39. A very low level may be dangerous since some sodium and chlorine are absolutely essential and if continued too long drastic restriction will result in mineral imbalance and loss of appetite will inevitably result because of unpalatability of the diet. This may lead to malnutrition and further body dysfunction due to deficiencies. *Patients on low  $\text{NaCl}$  intake should be under strict medical supervision.* Conversely when profuse sweating, prolonged vomiting, or severe diarrhea have resulted in excessive salt loss to the body, extra salt should be provided to prevent tissue dehydration.

Salt ( $\text{NaCl}$ ) restriction is practiced less today than sodium restriction. It has been found that it is the sodium ion and not the chloride which is the offender in water retention (400 mg sodium is equivalent to approximately 1 gm  $\text{NaCl}$ ).

**Chlorine** The major part of chlorine is combined with sodium to form sodium chloride. Chlorine as chlorides particularly sodium chloride is present in all secretions, excretions and body tissues. The hydrochloric acid of the stomach arises from chlorine supplied to the gastric glands by the blood. The chlorides are among the most important of the body regulators. They control the osmotic pressure of body fluids and thereby control

the passage of water in and out of body tissues. This is a point of great importance in dehydration where tissue water is greatly reduced and in edema where tissue water is greatly increased.

**Magnesium** is present in the chlorophyll or green coloring matter of plants and forms approximately 1% of bone and tooth structure. It is present also in all soft tissue and in body fluids. On a diet containing an adequate intake of plant and animal food the magnesium requirement is easily met. However if animals are maintained for a period of time on a diet devoid of magnesium there is an increase in heartbeat, blood vessel dilatation, increase in irritability and finally convulsions and death. Magnesium therefore is essential to life although in just what manner has not been established.

**Manganese** is another element known to be essential to life although its specific function is unknown. However sterility in male rats and lack of maternal instinct in female rats and a leg deformity in chickens (perosis) develop when manganese is withheld from the diet.

**Copper** is in general so closely associated with iron that adequate intake of iron assures adequacy of copper. Liver, oysters, molasses, chocolate and cocoa are all excellent sources of copper. The 1947 recommended allowances suggest 1 to 2 mg daily—approximately one tenth that for iron. Copper is an important factor in the utilization of iron for the formation of hemoglobin rather than as a constituent of hemoglobin. Mc Lester suggests that it does not influence the assimilation of iron but acts merely as a catalyst in the transformation of this element into hemoglobin thus giving it a function unique among the metals.

Fluorine has recently been studied with interest in connection with tooth disorders in particular the mottled enamel known as fluorosis. In some cases excess fluoride has been to such a great degree that it has apparently interfered with the normal calcification of the teeth so that they become structurally weak. The fluorine content of water in some localities is high enough to bring about such changes. This is an instance where excess rather than a deficiency is serious. However, fluorine intake below a minimum level may be a contributing factor in dental caries. (See discussion in Chapter 14.)

Cobalt, bromine, aluminum, zinc, and other elements are found in very minute amounts. They are spoken of as trace elements and their specific functions are unknown. The determination of the formula for vitamin B<sub>12</sub> revealed the fact that cobalt is a constituent of that vitamin. However, to date, a human requirement for cobalt apart from its relationship to vitamin B<sub>12</sub> has not been determined.

Shohl suggests the approximate daily requirements for the normal man as given in Table 40.

TABLE 40

Na	40 gm	P	13 gm	Fe	120 mg
K	25 gm	S	13 gm	I	0.1 mg
Ca	0.8 gm	Cl	60 gm		
Mg	0.3 gm				

### Acid Base Balance

The subject of acid base balance is one of complicated chemistry and must appear so in spite of an effort to simplify. The simplest solution may be to omit it, however, for the sake of the over all coverage of the subject of nutrition, it seems wise to include a brief survey for those who desire to read it.

In discussing the minerals, it has been pointed out several times that they function to regulate the blood neutrality and to maintain the acid base balance of the body. The elements calcium, sodium, potassium and magnesium are alkaline. Phosphorus, sulfur and chlorine are acid. The preponderance in a food of one group over the other is the deciding factor in determining whether that food will after metabolic breakdown completely yield an acid or an alkaline (basic) ash, or will result in an acid or alkaline urine, inasmuch as these constituents which are not taken up by the body are largely eliminated through the kidneys in the urine. *Milk, fruits and vegetables are base forming, cereals, meats, and eggs are acid forming.* It seems paradoxical that foods containing the fruit acids are reduced to an alkaline ash in the process of utilization, but this is quite true. Occasionally, as for instance in prunes, cranberries and plums, an acid not utilizable by the body is present in sufficient amounts to mask the alkalinity of the minerals in the food and the food then produces an acid urine. The degree of acidity or alkalinity

TABLE II

## Principal Minerals—Their Functions and Important Sources

MINERALS	FUNCTION	EFFICIENCY SYMPTOMS	PRIMARY SOURCES
Calcium	Essential for bone and tooth formation Essential for clotting of blood Aids in regulation of nerve and muscle action Essential for normal heart action	Poor bone and tooth formation	Milk Cheese, American Kale Egg yolk Greens, mustard and turnip
Phosphorus	Essential for bone and tooth formation Essential for metabolism of protein fats and carbohydrate Constituent of every cell in body	Poor bone and tooth formation Impaired food metabolism	Milk Cheese, American Eggs Legumes Meats and fish Nuts
Iron	Essential for formation of oxygen-carrying hemoglobin of the blood Essential in cell metabolism	Some types of anemias	Liver Lean meats Egg yolk Legumes Enriched breads and cereals Green leafy vegetables
Copper	Essential for metabolism of iron Used as coloring in hair and skin	Produced in animals	Legumes Liver Meats Whole grain cereals and bread
Iodine	Essential for normal functioning of the thyroid gland	Simple goiter	Sea foods Plants grown in soil near sea Iodized salt
Sodium	Aids in regulation of water balance Aids in maintaining acid-base balance Essential for muscle contraction	Unknown	Table salt Salted fish and meats Canned meats, fish, vegetables Cheese Milk Margarine
Chlorine	Aids in regulation of water balance Aids in maintaining acid-base balance Constituent of gastric digestive secretion (HCl)	Unknown	Table salt Salted fish and meats Olives Canned meats, fish, vegetables



of a food is expressed in terms of the quantity of normal acid or alkali to which it is equivalent (see Chapter 38, Table 108)

Blood and body tissues are nearly neutral in reaction (pH 7.4). When a solution is exactly neutral, it is said to have a pH (hydrogen ion concentration) of 7.0. Below this value, i.e., pH 6.0, 5.0, etc., the solution becomes increasingly acidic, and above it, at pH 7.5, 8.0, etc., it becomes alkaline. The designation pH is used to express the balance between acid and alkaline elements. However, if the blood pH reaches 7.0 in the body, acidosis is present, and at 7.8, alkalosis. The ability of the blood to be held within such a narrow pH range is due largely to the blood buffers. This constancy is maintained in spite of wide variation in the pH of urine. Urine may be acid or alkaline. In addition to the buffers, two other factors are operative in maintaining this balance—the lungs and the kidneys.

Food, after digestion, is carried to the tissues where it is oxidized. The organic material which is not needed immediately is changed to carbon dioxide and water, and the mineral elements are set free. The acid radicals (elements) are immediately neutralized by alkaline radicals, if both are set free simultaneously. If not set free at the same time, they are neutralized by the alkali reserve. At all times there is an excess of alkali (largely sodium bicarbonate) held in the body as reserve alkali. When alkaline radicals in excess of those used to neutralize the acid radicals are released, they are added to this reserve store. This supply may be called upon at any time to release alkali for the neutralization of acid. When this need arises the carbonic acid salts (carbonates) of the alkaline elements react with the circulating acid in such a way as to tie up that acid and release the weak carbonic acid. This carbonic acid is immediately and readily eliminated through the lungs as carbon dioxide and water. Obviously, if a diet devoid of sodium is ingested, the alkali reserve is depleted, and with this major buffer removed, the blood acid increases and acidosis probably results.

The term acidosis is loosely used. True acidosis is rare. In correct usage of the term only an upset in acid base (alkali) balance of the blood results in acidosis. When an acidosis results from an incomplete combustion of fat, it is a ketosis (the acidosis of diabetic coma).

The blood neutrality is further maintained by the action of other buffers which are capable of tying up with free radicals, namely, the phosphates, amino acids, and proteins.

In addition, the kidneys may produce varying amounts of ammonia, which also functions to maintain neutrality.

See Chapter 38 for a detailed table of the acid or basic effect of foods.

### Review Questions

- 1 Of the many minerals important in human nutrition, what three require special calculation in the dietary? Why these three?
- 2 How do minerals function in the body?
- 3 What special functions does calcium fill? Phosphorus? Iron?
- 4 What is the standard daily amount recommended for an adult for each of these minerals?
- 5 What is the richest food source of calcium? Other good sources?
- 6 What foods contribute phosphorus? Iron?
- 7 Does age or sex affect the amount of these minerals needed?
- 8 What other minerals are necessary to human nutrition?
- 9 What minerals produce an acid ash after metabolic breakdown? What ones are alkaline?
- 10 What foods are acid forming? What base forming?
- 11 How is the neutrality of the blood and body tissues expressed?
- 12 What mechanism keeps the body tissues neutral or nearly so?

### Suggested Projects

- 1 Examine your own menus. Calculate the calcium content in one or two days' menus. Did the amount of calcium included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate calcium?
- 2 From the calculations obtained in No. 1, what per cent of the calcium in your diet comes from milk? From milk products?
- 3 Assuming that an adult dislikes milk, or does not include it in his normal eating pattern, how may he obtain his calcium? In what other forms will it be acceptable to him? Be sure that your suggestions are a practical solution to the problem.
- 4 Assuming that a teen age girl dislikes milk. Plan menus for her that will meet her nutritive needs yet be a diet she will follow, and do not include milk as a leverage in her diet.
- 5 Examine your own menus. Calculate the iron content in one or two days' intake. Did the amount of iron included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate iron?
- 6 From the calculations obtained in No. 5, what per cent of the iron in your diet came from enriched products?

of a food is expressed in terms of the quantity of normal acid or alkali to which it is equivalent (see Chapter 38, Table 108).

Blood and body tissues are nearly neutral in reaction (pH 7.4). When a solution is exactly neutral, it is said to have a pH (hydrogen-ion concentration) of 7.0. Below this value, i.e., pH 6.0, 5.0, etc., the solution becomes increasingly acidic, and above it, at pH 7.5, 8.0, etc., it becomes alkaline. The designation pH is used to express the balance between acid and alkaline elements. However, if the blood pH reaches 7.0 in the body, acidosis is present, and at 7.8, alkalosis. The ability of the blood to be held within such a narrow pH range is due largely to the blood buffers. This constancy is maintained in spite of wide variation in the pH of urine. Urine may be acid or alkaline. In addition to the buffers, two other factors are operative in maintaining this balance—the lungs and the kidneys.

Food, after digestion, is carried to the tissues where it is oxidized. The organic material which is not needed immediately is changed to carbon dioxide and water, and the mineral elements are set free. The acid radicals (elements) are immediately neutralized by alkaline radicals, if both are set free simultaneously. If not set free at the same time, they are neutralized by the alkali reserve. At all times there is an excess of alkali (largely sodium bicarbonate) held in the body as reserve alkali. When alkaline radicals in excess of those used to neutralize the acid radicals are released, they are added to this reserve store. This supply may be called upon at any time to release alkali for the neutralization of acid. When this need arises, the carbonic acid salts (carbonates) of the alkaline elements react with the circulating acid in such a way as to tie up that acid and release the weak carbonic acid. This carbonic acid is immediately and readily eliminated through the lungs as carbon dioxide and water. Obviously, if a diet devoid of sodium is ingested, the alkali reserve is depleted, and with this major buffer removed, the blood acid increases and acidosis probably results.

The term acidosis is loosely used. True acidosis is rare. In correct usage of the term, only an upset in acid-base (alkali) balance of the blood results in acidosis. When an acidosis results from an incomplete combustion of fat, it is a ketosis (the acidosis of diabetic coma).

The blood neutrality is further maintained by the action of other buffers which are capable of tying up with free radicals, namely, the phosphates, amino acids, and proteins.

In addition, the kidneys may produce varying amounts of ammonia, which also functions to maintain neutrality.

See Chapter 38 for a detailed table of the acid or basic effect of foods.

### Review Questions

- 1 Of the many minerals important in human nutrition, what three require special calculation in the dietary? Why these three?
- 2 How do minerals function in the body?
- 3 What special functions does calcium fill? Phosphorus? Iron?
- 4 What is the standard daily amount recommended for an adult for each of these minerals?
- 5 What is the richest food source of calcium? Other good sources?
- 6 What foods contribute phosphorus? Iron?
- 7 Does age or sex affect the amount of these minerals needed?
- 8 What other minerals are necessary to human nutrition?
- 9 What minerals produce an acid ash after metabolic breakdown? What ones are alkaline?
- 10 What foods are acid forming? What base forming?
- 11 How is the neutrality of the blood and body tissues expressed?
- 12 What mechanism keeps the body tissues neutral or nearly so?

### Suggested Projects

- 1 Examine your own menus. Calculate the calcium content in one or two days' menus. Did the amount of calcium included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate calcium?
- 2 From the calculations obtained in No. 1, what per cent of the calcium in your diet comes from milk? From milk products?
- 3 Assuming that an adult dislikes milk, or does not include it in his normal eating pattern, how may he obtain his calcium? In what other forms will it be acceptable to him? Be sure that your suggestions are a practical solution to the problem.
- 4 Assuming that a teen age girl dislikes milk. Plan menus for her that will meet her nutritive needs yet be a diet she will follow, and do not include milk as a beverage in her diet.
- 5 Examine your own menus. Calculate the iron content in one or two days' intake. Did the amount of iron included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate iron?
- 6 From the calculations obtained in No. 5, what per cent of the iron in your diet came from enriched products?

## CHAPTER 14

### THE RELATION OF NUTRITION TO THE TEETH

*Nutrition has been shown to be of primary importance in the formation of sound teeth. The diet of the mother prior to and during the prenatal period and the food habits of the young child supply necessary nutrients. Dental caries is widespread, with an especially high incidence among children and young adults. The cause of this condition is debated. Several theories have been advanced which are thought to be effective in controlling caries. Dietary management may be of value.*

The interest today in nutrition as it relates to the teeth is two fold. Of primary importance is the role that various nutrients play in the formation of sound teeth and healthy supporting structures, and, equally as important, is the possible influence that foods and nutrition may have in reference to dental caries. It is impossible to discuss one without considering the other as many investigators believe that the former has a determining effect upon the latter. The incidence of dental caries is so wide spread that it is considered a menace and a public health problem.

It is currently believed by many that nutritional status of the mother before conception has an important effect upon the health of both the child and the mother (see Chapter 18). This may also have an influence upon the development of the teeth of the fetus as well as a strong healthy body. Also, if the mother has established good nutritional habits for herself, the young child will probably be used to a well balanced diet pattern.

Prenatal conditions affect the first set of teeth. The tooth buds for the deciduous teeth (the "baby teeth") are distinguishable at the eighth week of prenatal life. Both the dentine and enamel are thought to begin calcifying about the fourth fetal month. (See Fig. 50 the cross section of a tooth.) By the time the child is born the sixth year molars (the first of the permanent teeth to erupt) are beginning to calcify, hence, it is obvious that if teeth are to be perfectly developed, structural material for them must be adequate during prenatal life. Minerals

vitamins especially an adequate amount of vitamin D, and amino acids are primarily needed. If this material is not supplied by the mother's food, her body stores will be called upon, these may not be equal to the nutritional needs. This may be



Fig. 49 Relation of blood supply to structure of the teeth. The black lines represent the blood stream which supplies the teeth with food. (From *If Food Could Talk*, Cornell University Bulletin J 44.)

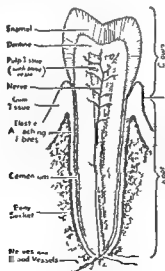


Fig. 50—Cross section of a tooth. Each tooth is composed of three parts: the crown above the gumline, the roots below, and the neck where crown and roots meet. The crown is covered with enamel, the hardest material in the body, and the roots are covered with a thin layer of bone-like material called dentine, which lies underneath these outer coverings. Enclosed within the dentine is a hollow space called the pulp chamber where the life of the tooth is maintained. (Courtesy Metropolitan Life Insurance Company.)

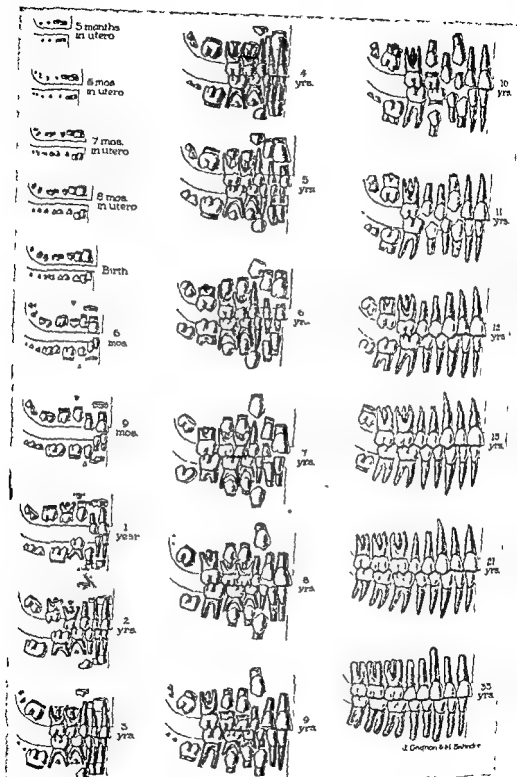


Fig. 51 —Development of the human dentition (Courtesy Dr I. Schour and Dr M. Massier, University of Illinois, College of Dentistry)

a distinct disadvantage to the tooth development of the child and to the tissues of the mother.

Mellanby showed that in dogs the improper feeding of the mother during pregnancy had a deleterious influence upon the tooth structure of the young. The work also tends to show clearly that a diet which will produce rickets also tends to interfere with proper calcification and enameling of the teeth. Pregnant sows on the other hand were found by Klein, McCollum, Tuckley and Howe to make sufficient sacrifice of their own reserves to insure normal teeth to the young at birth.

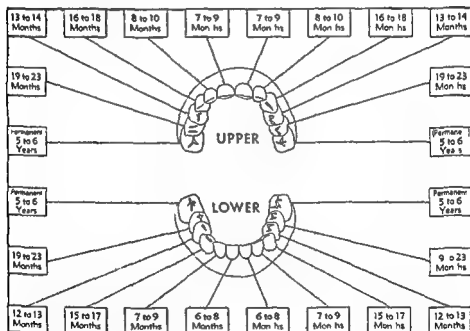


Fig. 50.—Baby's first teeth. (Courtesy Calf in a Fruit and Raisin Exchange.)

Thus the tooth is now believed to be a living structure and as such must have adequate nourishment for growth. Any wide departure from an adequate diet appears to be reflected in tooth health or tooth setting, since the surrounding gum tissue must be considered with the teeth proper. Fig. 51 represents a schematic development of the human dentition both prenatally and postnatally.

Specific dietary deficiencies have been shown to result in specific changes in the teeth as indicated by vast data which have



been accumulated. Vitamins A, the B group, and C, in addition to vitamin D, as well as calcium and phosphorus are shown to be essential for development of normal tooth structure, but not in amounts greater than those ingested in the normal adequate diet, with the exception of vitamin D.

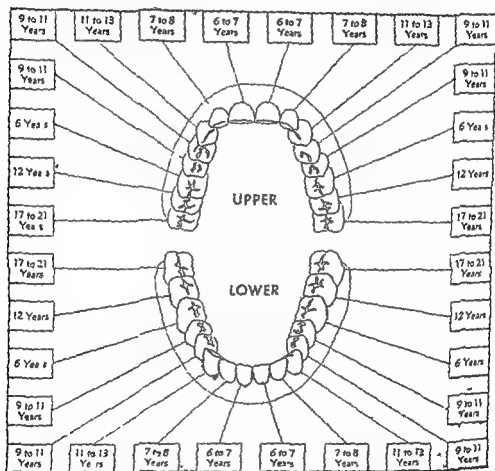


Fig. 54—The permanent teeth (Courtesy California Fruit Growers Exchange)

In summarizing the role of the diet in the formation of the tooth and in its relation to the possibility of later development of dental caries, Leicester has observed "There is good evidence that the structure of the tooth itself may play an important part in determining whether the tooth will subsequently resist attack by microorganisms. The structure is determined either by conditions which prevailed in the organism when the tooth was formed or by post-eruptive changes in composition and structure."

Many surveys have revealed the great extent to which dental caries exist as a disease. From the present information gathered by such surveys it has been estimated that half of all 2 year old children have one or more decayed teeth, less than 20 out of every 100 high school pupils are free of decayed teeth, and at 16 the average youth has seven decayed, missing or filled teeth involving 14 tooth surfaces. These are startling data. Today, research is directed toward discovering means whereby this extremely high incidence of caries may be reduced once the teeth have been formed.

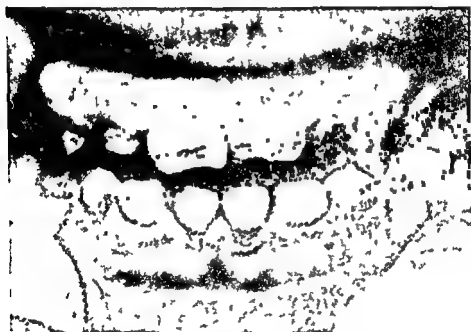


Fig. 54. Vitamin D deficiency affects the teeth. The lack of calcium, phosphorus and vitamin D affects the teeth. The 11 year old child had severe rickets when 8 months old. Under treatment with vitamin D (Cody Wisconsin Nutritional Research Foundation).

Diets pointed out that our efforts are governed by two key words: control and prevention. According to him, control of dental caries indicates only a means of reducing the rate of dental caries formation; hence to a certain extent we can control caries. But to date there is no way to prevent caries. Recently there have been several methods suggested which are thought by many to be beneficial in decreasing caries.

One, the use of *fluorine*, is concerned with tooth development. Mottled enamel is characteristic of individuals living in districts where the fluorine content of the water is high. The teeth appear dead white and unglazed, and are pitted, corroded, and structurally weak. Curiously enough, however, field studies have shown that there is a lower incidence of caries in the areas of mottled enamel. Rats have been shown to develop less caries on a caries producing diet when fluorine is added to the diet. Fluorine seems to reduce both the acid production of the oral bacteria and the solubility of the dental tissues. Data suggest that for children in the early years of life (the first eight), when tooth formation is taking place, drinking of fluorine containing water has definite effect in holding the incidence of caries to a level lower than that of children drinking water containing little or no fluorine. It is believed that such caries resistance acquired during tooth formation continues through adult life, however, little evidence is available to support this latter contention.

The use of fluorine during tooth development may occur in two ways. One has been the incorporation of fluorine in the drinking water. The U. S. Public Health Service has added fluorine to the drinking water of several communities and used other communities as controls in order to determine the effectiveness of this method. Preliminary reports indicate that it is a practicable and partial solution to caries control. Other communities have voluntarily artificially added fluorides to the public drinking water.

It had been found that when water contains one part per million of fluorine the "critical" point is reached between mottled enamel and reduction of caries. More than this concentration produces mottling and appears to have no greater protective value against decay. Accordingly, this (1 part per million) is the accepted optimum level of concentration.

Objection has been raised by some to this practice on the basis of the toxicity of fluorine. Fluorine is highly toxic in large amounts. (Rodent poison is a potent source of fluorine.) A single massive dose—roughly 10 gm—may be fatal within hours. However, in the extreme dilution of 1 part per million, not the slightest toxic effect could be had regardless of the amount of water drunk. A toxic dose of roughly 10 gm would require the

ingestion of 2 500 gallons of water fluorinated to the extent of 1 part per million (1 gm in 2 0 gallons) within a few minutes of time

A second method of incorporating fluorine in the formation of the tooth is its use by the practicing dentist. A 2% solution is applied by the dentist at stated intervals (usually weekly for four weeks) directly to the dried surfaces of the tooth. A variety of results have been reported as it seems to reduce caries in some children whereas in others it is ineffective.

Another method which is suggested in caries control is through diet restriction. This school of thought explains the incidence of dental caries on the basis of a chemioparasitic theory, namely that there is localized destruction of first the enamel and then the dentine due to acid products of fermentation of carbohydrate foods resulting from microorganism activity chiefly *Lactobacillus acidophilus*. Bunting, one of the early supporters of this latter theory, believes that continuous action of this sort will eventually affect even the strongest teeth. Decrease in carbohydrate intake especially sweets coupled with proper brushing and the filling of precarious pits which can readily become little lactic acid factories have been shown by experimenters belonging to this school to result in a decrease in the incidence of caries.

Blayney, director of the Zoller Dental Clinic of the University of Chicago, feels that corrective measures have failed. The dental profession is totally unable to halt tooth decay by the placement of fillings. Preventive steps are imperative if progress is to be made. He too is convinced that the mineral salts of the teeth are removed and decay is started by the presence of an acid on the tooth surface thus giving support to the chemioparasitic theory. He believes that it is not necessary for the food particles themselves actually to remain on the teeth; passage of fermentable material through the mouth is sufficient. The American people, especially the American youth, consume much more sugar than dietary standards suggest. A report published in 1946 by the Department of Agriculture (Bureau of Agricultural Economics) estimated that 713 000 tons of sugar were used in bottled beverages within that year and that candy utilized 491 000 additional tons. Soft drinks are approximately 10% sugar solutions. The food patterns of Americans of all ages in

dicates that sweets, sweet drinks, sweet pastries and sweetened coffee are frequently consumed between meals. This practice may be a factor in constantly reinforcing a relatively high local acidity and thereby contribute to a caries-producing environment.

Thus, it is believed that by restricting the injudicious use of sugar and highly fermentable foods dental caries may be controlled. All too frequently these foods reduce the desire for the more important foods and natural sugars. If the child eats the proper amounts of foods which provide the recommended allowances of essential nutrients, he will have little time or appetite for undesirable snacks. In between feedings should be a planned part of the daily menus (see Chapter 20), and if sweets are not given as rewards for good behavior, their desirability may be diminished. Parents can establish good food patterns in children so that they will not need to rely on frequent intakes of concentrated sweets in order to obtain the calories necessary for growth.

Dr. Genevieve Stearns has offered an interesting possibility which deserves consideration when dental caries persist in spite of an apparent adequate dietary intake. In discussing mineral nutrition, she reports several cases. Briefly, one case. A 14-year-old girl came to the clinic "because of sudden and devastating dental caries—some 26 cavities appeared within a few months." Clinical examination gave no clue. Metabolic study indicated that calcium and phosphorus were not retained in spite of an adequate diet. The vitamin D intake was also satisfactory. The girl's vitamin A status was measured and found to be subnormal. Evidently, vitamin A absorption was below par, if so, vitamin D absorption should likewise be below par. Bile salt therapy was instituted in order to facilitate fat absorption. Within a few days, calcium and phosphorus retention returned to normal, the vitamin A status was improved, and the caries were arrested. Failure to utilize dietary vitamins A and D may well be subjected to further investigation.

An interesting suggestion came from Gottlieb who was at Baylor College of Dentistry. He pointed out that teeth are unique in that unlike the rest of the body they lack a layer of protective epithelial tissue which is constantly sloughed off and renewed, thereby protecting the underlying tissue from invasion.

Teeth instead have a hard sheet of enamel which covers the underlying dentine. Why this hard protective coat should be vulnerable to bacterial invasion has been a puzzling question. The attack by acid seemed a solution and the production of the acid by bacterial action on carbohydrates logical, but in assuming that bacteria are the cause they are 'mistaking an effect for a cause'. In the opinion of Gottlieb, the explanation lies in the fact that organic threads (lamellae) of noncalcified material run through the enamel. These represent 5% of the enamel. This fact has been known since 1878 but its significance not appreciated. The longer of these threads extend from the outer surface to the inner dentine which is only 73% calcified. It is through these lamellae that bacteria 'under favorable conditions for them' reach the dentine where decay can proceed. This accounts for the extent of decay which sometimes is present in spite of an apparently intact enamel. Perhaps in time the cause of the bacterial invasion will be found, but in the meantime Gottlieb proposes to 'close the lamellae against invasion'. He accomplishes this by precipitating an insoluble salt within them. A chemical compound (a zinc chloride potassium ferrocyanide salt) placed upon the teeth at appropriate intervals impregnates the lamellae and produces block. With these treatments Gottlieb has reduced the dental caries in 90% of his cases.

He challenges the theory that fluoride acts through inhibition of acid. He suggests instead that it acts rather by attracting calcium to itself in the lamellae thereby forming an insoluble salt block.

If one considers the evidence it seems sensible to take a mid course to fight dental caries with personal and professional care of the teeth and the ingestion of a diet containing adequate calcium phosphorus vitamins A B group D and C and *carbohydrate in moderation*. To assure these substances the diet should include the daily quart of milk one egg a glass of citrus fruit juice or some other potent source of vitamin C at least one other fruit or raw green leafy vegetable a generous serving of butter or margarine and a fish oil of some kind unless the diet is fortified or unless irradiated milk containing 400 USP units of vitamin D is used. Candy should be curtailed and simple desserts or fruits should replace the sweet and rich dishes. The curtailment of carbohydrate will naturally result in a compensatory

increase in fat if the caloric level is kept constant. This type of diet has been reported to be beneficial in promoting tooth health. In fact, it is the diet which should promote optimum nutrition. In other words, adequate structural material during the period of tooth formation with protection of the teeth by curtailment of sweets—especially sticky sweets—and the careful removal of film with its possibilities for bacterial action after eating should be the basis of tooth care.

It must be kept in mind that the actual cause for dental caries is unknown. There are many influences beyond the scope of the present discussion which may be contributing factors, such as heredity, the composition of saliva, and the actual mechanism whereby an area of the tooth decays. It is generally accepted, however, that the health of the tooth and its surrounding structures is closely related to the health of the individual. It is believed that good nutrition can profoundly affect the formation of the teeth and probably is a major factor in maintaining sound teeth.

### Review Questions

- 1 What is the relationship between prenatal nutrition and strong teeth?
- 2 What nutrients have specifically been shown to be essential for normal tooth structure?
- 3 How may the terms "control" and "prevention" be used in speaking of dental caries?
- 4 What theories have been suggested concerning nutrition and dental caries?

### Suggested Project

- 1 Examine your own menus. Does your food pattern resemble any that was discussed in the preceding pages? Evaluate.

## CHAPTER 15

### WATER BALANCE

Although not considered as a nutrient by many, water is extremely important to health. Loss of small amounts of water may result in serious complications. Water is obtained in several forms as a beverage, as preformed water and through metabolism. Water is lost from the body in three ways, in the urine through evaporation, and in the feces. The water regulating mechanism, thirst, is so effective that the individual normally obtains enough water for his metabolic needs.

Approximately three quarters of the body weight is due to its water content and in the opinion of Peters and his co-workers about one third of this is extracellular (outside the tissue cells) and two thirds is within the cell itself. Disturbances of this equilibrium may be serious. Water balance studies are steadily assuming importance. Water has greater importance than any of the foodstuffs. It is second only to oxygen. Life can go on many weeks without food, but cannot be maintained even half a week without water. In fasting, practically all of the body fat and half of the body protein may be lost before death occurs.

Loss of 10% of the body's water results in serious disorder, a loss of 20% results in death. Death from water loss is not due to actual decrease as such but to the upset in all of the metabolic processes due to the decreased availability of water. Every cell requires water both for structural existence and function.

Water is the basis of blood, which is the vehicle of transport within the body. By way of the blood, food supplies and oxygen are carried to the tissues and waste products including carbon dioxide are carried away to their port of exit. By means of its elimination through the skin, water is a factor in heat control. It is the solvent for urinary solids. With extreme water shortage or even sharp curtailment, kidney function is impaired. Water is the solvent for the body minerals and so basically aids in all their functions (see Minerals Chapter 13). The tremendous value of adequate water, especially in illness is evidenced by the



much more rapid improvement when fluids are forced directly into the body tissues of those patients who are unable to take water by mouth in adequate amounts

Water is made available to the body in three forms, as beverages, as preformed water in foods (milk is 87% water, fruits 85%, and even dry cereals contain 10% water), and, finally, as the result of metabolic processes (metabolic water). When the body metabolizes food, water is one of the end points of the reaction, for example, Magnus Levy found that 100 gm of fat results in 107 gm of water, 100 gm of starch results in 55 gm of water, and 100 gm of protein in 41 gm of water. This metabolic and preformed water is utilized by body tissues just as though it were ingested water.

Water is lost from the body in several ways, by evaporation through the lungs and from the body surface, in the urine, and in the feces. While the major part (500 to 3,000 cc) is lost through the kidneys as urine, the amount lost by other routes may at times be appreciable (in feces during diarrhea, etc.). Soderstrom and DuBois outline a typical day (Table 42).

While at times it may be necessary to alter fluid intake, the average intake as fluids of from 1,000 to 2,000 cc daily is satisfactory. To a large extent, salt (NaCl) intake regulates this ingestion.

It has been suggested that a rough approximation of the water need may be made by allowing 1 cc for every calorie of expended energy. As a rule, two thirds of this comes from food sources and one third is ingested as fluids.

TABLE 42

Water Intake		Grams
Drinking water		300
Water in tea, coffee, etc		580
Water in solid food (preformed)		720
Metabolic water from protein (100 gm)		41
Metabolic water from fat (110 gm)		118
Metabolic water from carbohydrate (244 gm)		135
		<hr/> 1 894
Water Output		
In urine		750
In feces		300
Vaporized from skin and lungs		700
		<hr/> 1 750

In general thirst which depends upon food and  $\text{NaCl}$  intake, on activity, and on temperature governs water intake. Water passes unchanged through the digestive tract and is absorbed largely from the intestinal tract. Only small amounts are absorbed from the stomach.

When more water is lost from the body than a corresponding amount of salt, thirst is immediately felt as indication of need for water intake. When salt losses are greater than the equivalent amount of water which would be necessary to maintain

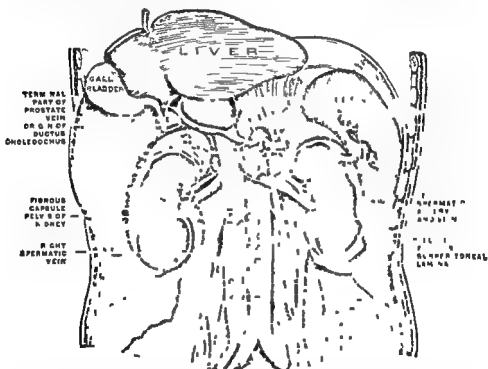


FIG. 50.—The kidneys and the urinary bladder. The two kidneys are shown within the body cavity. Their advantageous connections with the chief artery and vein of the system are indicated. Below is the bladder reached by the two ureters. These vessels enter the bladder down and behind not at the level where the kidneys lie. (After Sappey from Gray's Anatomy Lea & Febiger.)

the proper salt concentration of the tissues (the physiological salt level) characteristic symptoms develop—weakness and severe cramps so called heat cramps since they may occur as a result of excessive perspiration due to heat or violent exercise. Administration of oral salt is necessary to correct this condition. Water alone will not even though great water loss has also taken place.

On a weight basis, children have a higher need for water than adults. For example, the infant has a requirement three times that of the adult—his extracellular water is twice as high, his metabolic rate greater, and his kidneys less efficient. Adequate fluid intake is especially important in the early years. Dehydration takes place quickly in children. (See Table 61.)

Water intoxication, on the other hand, can result when excessively large amounts of water are forced. The symptoms include nausea, vomiting, tremor, restlessness, frequency of urination and bowel movement, ataxia, convulsions, and coma.

As indicated previously, the major portion of the water in the body is lost through the urine. In order to appreciate the importance of the regulation of water metabolism and essential nutrients, a brief statement of the kidneys and their functions is in order.

The kidneys are paired, bean shaped organs, about 4 inches in breadth and 1 inch in thickness, placed to the right and left of the vertebral column, just below the diaphragm. The aorta and inferior vena cava pass between them and assure them of a copious supply of blood.

Long, winding tubules, originating near the surface of the kidneys, can be seen microscopically. These are secreting units conducting urine toward the concave border. A knot of capillaries (glomerulus) appears at the beginning of each tube. Traveling contractions (peristaltic waves) propel the urine through the ureters into the bladder.

Urine is a yellowish liquid, colored by the substances related to bile pigments. Under ordinary circumstances of diet and health, urine is slightly acid. It becomes alkaline, however, on standing, due to bacterial fermentation of urea and formation of ammonium carbonate. As the result of the change, an ammoniacal odor develops and a cloudy deposit may appear. About seven eighths of the nitrogen excreted in the urine is in the form of urea. The remainder is divided among various other nitrogenous waste products, one of which is uric acid, a substance distinguished by its scant solubility and consequent tendency to be retained as in gout (see Chapter 33).

Inasmuch as all proteins contain sulfur, and some contain phosphorus and since these leave the body by way of the urine, phosphates and sulfates, in solution, are found there, as well as con-

TABLE 43  
THE WATER CONTENT OF VARIOUS FOODS

FOODS 100 GRAMS EDIBLE PORTION	PER CENT WATER
Apple raw	84.1
Orange juice, fresh	87.5
Spinach, cooked	90.8
Ice cream, plain	62.1
Dried prunes, uncooked	24.0
Bread, white, enriched, 2% nonfat milk solids	74.5
Butter	15.5
Beef, round, cooked	51.0
Cheddar cheese	37.0
Corn flakes	3.0
Carrots raw	88.2

Adapted from Composition of Foods Raw Processed Prepared U S Department of Agriculture Handbook No. 8

TABLE 44  
PHYSIOLOGICAL CONSTITUENTS OF URINE\*

Normal urine varies widely in composition, being influenced by diet and other factors. The following represents the composition of average normal daily excretion of the constituents.

CONSTITUENTS	AMOUNT IN GRAMS
Water	1200
Solids	60
Urea	30
Uric acid	0.7
Hippuric acid	0.7
Creatinine	1.2
Indican	0.01
Oxalic acid	0.02
Allantoin	0.04
Amino acid nitrogen	0.2
Purine bases	0.01
Phenols	0.2
Chloride as NaCl	12.0
Sodium	4.0
Potassium	2.0
Calcium	0.2
Magnesium	0.15
Sulfur total as S	1.0
Inorganic sulfates as S	0.8
Neutral sulfur as S	0.12
Conjugated sulfates as S	0.08
Phosphate as P	1.1
Ammonia	0.7

\*From Hawk, Oser and Summerson, *Physiological Chemistry*, ed. 1\*, Philadelphia 1947, The Blakiston Company.

siderable amounts of sodium chloride. In addition, small amounts of creatine, creatinine, hippuric acid, acetone bodies, and other constituents are present. When any of these constituents exceeds in either direction the normal range found in health it assumes physiological importance and is of diagnostic value. Such findings are indicative of the location and extent of metabolic dysfunctions.

The blood, which is the precursor of these urine constituents likewise will reflect metabolic abnormality. To maintain normal composition of the blood is the main function of the kidneys. When the kidney function is impaired, there is accumulation of these constituents in the blood. The reader is referred to Table 20, Chapter 10 and to Table 44 where the important constituents of blood and urine are listed with their physiological levels.

The quantity of urine is influenced by many factors, chief of which is the fluid intake, and next, the activity of the sweat glands. It is important that, whenever possible, fluid intake be such that the dissolved solids in the blood, which are removed by the kidneys, shall have adequate solvent to facilitate the excretion from the body. Between 1 and 2 liters of urine are normally excreted daily.

### Review Questions

- 1 Why is water of the greatest importance in the body?
- 2 What are the sources of water to the body?
- 3 What is another source in addition to food and fluid intake?
- 4 What is the total amount of water normally needed daily?
- 5 What percentage of body water could be lost before a serious effect would result?

### Suggested Project

- 1 Examine your own menus for one day. Calculate the amount of water found in the foods you ate. How much of your water intake was preformed in foods and how much in the form of liquids? How many glasses of water do you drink each day?

## CHAPTER 16

### FOOD ADJUNCTS

A word about food adjuncts or those articles used in the diet which have little or no food value in themselves but which give flavor and add variety.

These adjuncts have a definite and important place and should not be eliminated from any diet unless such elimination is specifically necessary. Used in moderation they are not harmful, used in excess they may be irritating and may defeat their purpose by making foods less palatable. Even in the diet of the child and the invalid the use of adjuncts in *moderation* is justifiable.

**Table salt** is usually classified under this heading and to some extent it belongs there. The effect of NaCl on palatability needs no comment. Certain amounts moreover are essential to health (see Minerals).

**Vinegar**, a dilute solution of acetic acid (4%) and other substances giving it its flavor adds savor to many otherwise flavorless foods. Pickling or the preservation of foods by the use of vinegar does however result in products less readily digested.

The spices owe their specific flavor to their volatile oils. Spices have been classified as stimulating condiments—eryenne white and black peppers mustard and horseradish. The aromatic spices include allspice anise cinnamon cardamom clove ginger nutmeg and the sweet herb group contributes dill marjoram sage thyme and savory. Variety may be given to an otherwise monotonous diet by the cautious use of spices with perhaps temporary omission of the stimulating condiments during periods of gastrointestinal weakness.

**Flavorings** are available in great number. In general they are prepared by soaking or grinding into alcohol the flavor-bearing product. Lemon and vanilla are the most commonly used extracts but those of aromatic spices are also procurable—almond mint nutmeg of roses wintergreen and others.

For coffee, cocoa and chocolate belong to the food adjuncts. Certain of their components have caused much controversy as to

their inclusion in diets for other than the normal adult, and here, again, *moderation* and proper preparation of the brew are probably the answer. There is little evidence that the daily cup of coffee with breakfast has any adverse effect, and it may make the difference between enjoyment and nonenjoyment of a meal. It is certain that too often coffee is forbidden for no good reason. Coffee consumption in the United States is high. It has been estimated that more than half the coffee produced in the world is marketed in this country. It is interesting to note that the consumption increased from 6 pounds per capita in 1909 to approximately 16.5 pounds per capita in 1952. In coffee, the important constituents are the alkaloid caffeine, caffeotannic acid and the volatile oil cafaeol. Decaffeinated coffees (Sanka, Kaffee Hag), powdered soluble instant coffee, frozen soluble instant coffee, and coffee substitutes usually made from cereals are available on the market today.

In tea the stimulating property is the alkaloid theine, which is identical with caffeine. The flavor of tea comes from the tannin and a volatile oil. The difference between green and black teas is in the preparation of the leaf for sale. Black tea darkened by oxidative fermentation has its tannin changed to a more soluble form than that in the original green leaf.

Excessive ingestion of the alkaloid and the tannin in either beverage results in overstimulation and irritation, and this should be avoided in health or in illness. Caffeine is known to raise blood pressure, stimulate the renal activity, and bring about a mild cerebral stimulation. It "clears the cobwebs." Coffee ingested with a meal slightly retards the emptying of the stomach and may thus increase the satiety value of the meal.

Chocolate and cocoa differ in their fat content, chocolate having roughly twice as much fat as cocoa. These two products likewise contain an alkaloid theobromine. Excessive use of this alkaloid in the diet of children is contraindicated but, again, moderation makes its use justifiable. Theobromine is similar to caffeine but does not exhibit its stimulating properties.

Recently there has arisen a popular idea that cocoa and chocolate have a marked effect on calcium utilization and that their addition to milk as in milk shakes, chocolate milk or cocoa is ill advised. This is another example of scientific findings being

overemphasized. It is true that cocoa contains oxalic acid and that oxalic acid ties up with calcium forming an insoluble salt which results in calcium loss to the body. However, the amount of oxalic acid in cocoa and the amount of cocoa or chocolate in these drinks make the effect of the addition of little importance. From the standpoint of habit formation plain or "white" milk probably is preferable but the argument for it on the basis of calcium loss is a bit farfetched.

**Soft drinks** are in general, sweetened, flavored water which has been carbonated under pressure. Such drinks are nonalcoholic and have *no food value except for their calories*. They contain approximately 10% sugar. Some carbonated beverages contain caffeine a fact which many do not realize. Confusion also exists concerning the fruit flavored drinks which are often believed to be fruit juices. Harvey estimated that in 1952 the per capita consumption of soft drinks in the United States averaged 173 bottles. In other words our national consumption was  $1\frac{1}{2}$  billion bottles.

A detailed discussion of alcoholic beverages has no place in a book such as this. They are food adjuncts however in the broad sense of the term. Within limits alcohol may serve as a source of fuel. It has a caloric value of 7 calories a gram and in amounts not to exceed 10 cc pure alcohol per hour, it can be oxidized by the body and yield at this level approximately 70 calories which can replace an equal caloric amount of carbohydrate or fat hence it does have a slight sparing action. It has no food value other than calories. Aside from the emotional psychological and depressant action its ingestion in large quantities may decrease the intake of essential foods a condition which is highly undesirable. Its excessive ingestion in addition to an adequate diet leads to obesity. When a calculated diet is necessary alcoholic intake cannot be ignored. Again the watch word—moderation marks the dividing line between desirability nonharmful and harmful effects.

### Review Questions

1. What value have vinegar spices herbs and flavorings in the dietary?
2. Are tea and coffee contraindicated in the diet of the adult? What is their value?



- 3 How do chocolate and cocoa differ from tea and coffee? In what component are they similar?
- 4 What is the value of soft drinks?
- 5 Has alcohol any nutritive value?

### Suggested Projects

- 1 Examine your own weekly menus. What food adjuncts did you include in your diet? Were they used judiciously?
- 2 Examine the menus or recipes of a culture pattern different from yours. Are food adjuncts similar or dissimilar from yours?

## CHAPTER 17

### FOOD HAZARDS, FOOD FADS, AND FOOD PROTECTION

Although advances in public health have been striking within the last half century, vigilant watch is necessary to maintain safe food standards. Laws and law enforcement agencies exist today as a protection to the American public. Another factor which governs the eating pattern of our country is food fads and fallacies. In spite of the present knowledge of nutrition, erroneous concepts are prevalent throughout the country. Sound education by reputable authorities seems to be the best method at present to combat the harmful effects of blind acceptance of food fads and fallacies.

In discussing food in relation to health the assumption is naturally made that a normal individual plus adequate diet equals health. However, at times an apparently adequate diet may actually result in ill health and may directly or indirectly cause disease. Because of a food sensitivity or allergy (Chapter 41) ingestion of a food may result in an undesirable reaction of varying degrees of severity. In this instance the individual and not the food is to blame, or the food may act as a vehicle for unfriendly organisms or worm infestations, or the food itself may be infected as in botulism, ptomaines, or in food poisoning. Food may be contaminated during the process of manufacture unless proper sanitary precautions are taken, and the contamination may be human or environmental.

#### Food Hazards

**Typhoid fever** in the past more than at present caused grave concern. Today we know it can be contracted only through carelessness in the observance of good sanitation, such as the disposal of human excreta. Carelessness here can result in underground seepage to wells, streams of water, or other water supply, and thereby cause spread of the disease. There may be improper supervision of the typhoid carrier, the individual who constantly harbors the typhoid bacillus in his intestinal tract.

without active sign of the disease, and who may never have had typhoid fever himself. This has resulted in more than one outbreak. Typhoid carriers should be kept from contact with any food supply. Various types of dysentery may become prevalent in a locality because of water supplies contaminated by human sources.

Tuberculosis, human or bovine, may be contracted from the ingestion of infected food.

In recent years many states have passed sanitation laws governing milk production. These laws require that all milch cows reacting to tuberculin test be destroyed. Pasteurization is rapidly becoming compulsory. This practice and clean herds are becoming effective weapons in the elimination of at least the intestinal form of tuberculosis in man, which is of bovine origin.

Undulant fever and septic sore throat may be acquired through milk as the carrier of the disease organisms. Such milk is contaminated by the infected cow or the infection may come directly by contact with the animal itself. Undulant fever with its recurring attacks and debilitating effect is a serious handicap of long duration. Milk may also be contaminated by the careless handler who may bestow typhoid, diphtheria, scarlet fever, or poliomyelitis-causing organisms. Again, the importance of the pasteurization of milk cannot be overemphasized. Even though a herd and handlers are inspected periodically, there exists the possibility of contamination between examinations.

Meats may be infested with tapeworm, and when eaten without proper cooking, infestation of the gastrointestinal tract is probable. Pork is not infrequently infested with a small, round parasitic worm known as trichina which, as it migrates from the intestinal tract into the muscles, gives rise to a grave clinical condition known as trichinosis, in which the reaction is severe and frequently fatal.

The products of bacterial metabolism are another source of food contamination. In this group belongs botulism. The organism (*Bacillus botulinus*) under anaerobic conditions (in which no oxygen is present) grows in organic matter and produces a toxin. No change in flavor warns of its presence, although gas formation takes place and may cause bulging of the can of contaminated food. This bacillus cannot grow in acid foods, but is

found occasionally in nonacid foods such as canned meats corn beans asparagus and peas. Unfortunately while the organism is killed in the canning process spores (or undeveloped bacilli encased in a shell) may have formed. These are heat resistant and may escape the first cooking. Later they develop and release an active organism which in turn produces more of the toxin. This is why the afore mentioned foods particularly if home canned should be brought to a brisk boil after the can is opened before the food is even tasted. The reheating destroys any newly formed organisms and their toxic secretion. Botulism fortunately is rare today because of modern vacuum process canning methods. The mortality in botulism is high. The onset of symptoms is from eighteen to thirty six hours after infection and includes either severe gastroenteric or nervous system upsets or both.

Ergotism is another example in which bacterial metabolism causes a toxin. This disease is caused by ingestion of "spurred" rye or rye on which the fungus parasite *Claviceps purpurea* has grown. Anesthesia and recurrent convulsions are the symptoms of this disorder.

Food poisoning may occur as the result of the presence of bacilli of the paratyphoid group (one of the intestinal groups). This infection produces diarrhea vomiting abdominal pain and fever in from six to twenty four hours after partaking of the infected food. Such contamination may occur in any type of food. Summer heat causes bacteria to multiply rapidly and the need for additional care in the handling of food during this season must be emphasized.

Many cases of food poisoning are in no way traceable to infected food but are caused by some temporary physical or psychic maladjustment on the part of the eater. Only when a group of individuals who have partaken of the same food are similarly affected can one assume that the fault lies in the food eaten.

Many gastrointestinal attacks are erroneously called ptomaine poisoning by the laity. A ptomaine is a breakdown product of nitrogenous material (a product of bacterial action). In general and fortunately by the time meat has reached the stage where this type of decomposition exists it is ostensibly unfit for human consumption. The mechanical clinging of bacteria to meat and

the resulting entrance of the bacteria into the gastrointestinal tract, is not ptomaine poisoning in the correct usage of the term.

A third group of diseases results from the ingestion of toxic substances, not of bacterial origin, in plants which are not intended for human consumption. Poisonous fungi have been mistaken for mushrooms, the root of the water hemlock, or monk's hood, has been mistaken for horseradish, and the young shoots of laurel for the wintergreen which they resemble.

Shellfish may be rendered unfit for food if taken from contaminated water. During the spawning season some fish should not be eaten.

Certain alkaloids, poisonous to man, develop in foods, for example, the increase in the solanin of potatoes during sprouting.

Occasionally accidental poisoning occurs. Foods may be roasted or dried in contact with coal gas which contains arsenic. Antimony may be absorbed by foods from cheap enamelled containers used for storage. This is especially true of food having high tartaric acid content. Lead water pipes, tinfoil old fashioned tin cans are all possible sources of lead poisoning. Today tin cans are coated with lacquer so that no chemical action can affect the food, and can contents may, therefore be left in the can after opening.

### *Food Fads and Fallacies*

Food fads and fallacies are rampant. At a time when health efficiency and economy are important, it becomes increasingly necessary to sort these out from the scientifically accepted food facts and discard them forever. Clever advertising needs intelligent understanding as a weapon of resistance. Neither food fads nor fallacies have support in scientific fact.

Food fads and fallacies are closely related, in fact, some make no distinction between them. A food fad, however, suggests a temporary pattern of high popularity, whereas a food fallacy is usually considered as a belief about foods which is handed down from one generation to another. Neither is based upon fact and a fallacy may owe its beginnings to a highly celebrated food fad.

Food fads often suggest that one or two foods will be a "cure all" for anything that ails the individual. Extravagant promises are made concerning foods. Of course no food is especially a

health food." Every food contributes to the health of the normal individual. Exception must be made for those who have digestive, absorptive, or metabolic derangement or who suffer from special food idiosyncracies or food allergy. And for the purpose of human nutrition "every food is pure when no injurious ingredient has been added in the processes of manufacture, storage, or distribution; when no spoilage or deterioration has taken place; and when no element of dietary importance has been removed from the materials produced by nature." No particular food "builds up resistance," can "purify" the blood, "break up a cold," or "cure insomnia."

One of the greatest perpetrators of food fads is the pseudo-scientist. He is characterized by his interest in selling his particular product. He may describe and discuss various products by referring to reputable research concerned with a problem which he thinks is similar. Often the research is quoted out of context and undue emphasis is given to a specific finding. As the pseudo-scientist may use a vocabulary rich in scientific terms (though the mistakes in such usage are not easily detected by the layman), he is able to persuade the gullible to accept the food fads he advocates. Some of his claims may be based on half-truths which only serve to make them seem more plausible to the layman. However, it must be kept in mind that the pseudo-scientist does not write for ethical professional journals nor does he present papers at conferences or conventions sponsored by reputable scientific organizations.

The fads which may actually be harmful are those which control diet patterns. The vegetarian diet which contains neither milk nor eggs will undoubtedly be deficient in protein of high biologic value.

Those who do not combine starches and protein because one digests in alkaline media and one in acid have only to study physiology to know that few foods are pure protein or starch. Foods are mixtures of foodstuffs—and what is more, when protein breaks down in the body, it yields practically one half of its weight as carbohydrate (see Chapter 5).

With the increasing emphasis upon obesity, perhaps those desiring weight loss are the most fertile soil for food fads. However, any easy way for rapid weight loss will of necessity involve a diet which is not properly adjusted. Of all diet fads, probably

those designed for weight loss are most dangerous (see Chapter 22). For the intelligent person, the subject of "Hollywood diets" can be dismissed with the single word DON'T!

That food fallacies or superstitions were deeply ingrained is evidenced by the answers to a questionnaire sent in 1932, asking parents and teachers of elementary school children in fourteen states if they believed that fish improved the brain. Fifty nine per cent of the parents and 32% of the teachers said "yes." Perhaps the knowledge that no one food is specifically a brain food is more general today than then, but the current prevalence of food fads is proof that the American public is still gullible. Such an idea probably arose from the fact that there are phospholipids in the brain and that there is phosphorus in fish. But so there is in other foods.

There are those who believe that water with meals is harmful or that it makes one fat. It is true that large quantities of cold water used to wash down mouthfuls of unchewed food are not desirable. Water, however, in moderation is advantageous. It helps digestion by facilitating the mixing of the gastric juice with food. Twenty minutes after drinking ice water, the stomach's temperature is again that of the rest of the body. Thus is the same time interval for it to reach body temperature after drinking a hot beverage. Water has no caloric value.

Common "table salt" is accused of being responsible for cancer, high and low blood pressure, tuberculosis, Bright's disease, gray hair, and baldness.

Cream, cheese, and butter have been credited with being the cause of deafness and pasteurized milk with bringing about heart lesions in children, fasting has been suggested as a cure for cancer and both milk and aluminum cooking utensils advertised as the causative factor. These claims obviously are known to be false by one trained in nutrition, but, unfortunately too few have this information.

Physical work is reputed to require extra merit. Two generations ago scientists disproved the idea that muscle work demanded protein. Carbohydrate is the first source of body fuel.

Rich foods are indigestible! How frequently one hears this said. Digestibility or indigestibility is a question of completeness of utilization. Therefore, fats are very digestible. Ease of

digestion is another matter. Fats do delay digestion and fat foods are usually compact and concentrated, hence, they do take longer to digest. This time factor is a matter of no concern to the normally healthy person. It may, however, make it preferable to limit excessive fat for small children and those with impaired digestion.

Red meat is not less wholesome than white. As a general rule, cooked fruit is no more digestible than raw. Most fruits are perfectly digestible in the raw state when ripe. Unripe fruit is not poisonous but it is digested more slowly than the ripe fruit where the carbohydrate (starch) has turned to sugar. Starch requires cooking to be effectively handled by the human body. Bananas are very well handled even by small infants.

Milk and sea food may be eaten in any combination and no difficulty will arise (if the food is unspoiled) unless some allergy or temporary disorder exists in the individual.

Seeds do not cause appendicitis, cheese and milk even if boiled, are not constipating, clear coffee is not less harmful than when sugar and cream are added, garlic has no therapeutic value, etc. The number of food fallacies in this country are endless. Each community, each family has its own. In the past, many of these fallacies were based on trial and error feeding methods, many were acceptable in the light of the knowledge available at that time. However, today we refer to them as "old wives' tales."

With a wide variety of foods from which to choose, why is there such concern about food fads and fallacies? The following of such practices may have adverse effects upon the individual. If there is a limited amount of money for food expensive unnecessary items may be purchased. This may result in an unbalanced budget so that there are insufficient funds for necessities other than food. By believing that a certain food or combination of foods will provide all that is needed, in nutrients, the individual may actually be eating an unbalanced diet, a diet lacking in necessary nutrients. An individual who becomes a zealous food faddist develops an unwholesome attitude toward food. He also may have a tendency to believe that he can treat himself by eating the so called "health" foods if "he doesn't feel well" instead of securing competent medical attention. It is wise, therefore, to secure information about foods from reputable



## PART II

### NORMAL NUTRITION

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#### CHAPTER 18

#### NUTRITIVE NEEDS IN PREGNANCY AND LACTATION

The health of both the mother and the fetus has been shown to be affected by the nutritional status of the mother. The mother often enters pregnancy in a state of poor nutrition. Thus she must improve her own health in order to bear a normal healthy child. The diet in pregnancy, which is easily adapted from the basic diet, emphasizes an increase in proteins, vitamins, and minerals. Calories are not increased as much proportionately as the other nutrients. Lactation makes even greater demands on the mother.

*It has been said that the capacity for reproduction is a function of the well being of the animal, and that dietaries which affect the general well being either adversely or favorably will affect this function in a like manner. In other words, the ability of an animal to reproduce and rear young successfully is a criterion of fitness and vigor. In fact, the nutritive value of a ration may be appraised by the number of healthy litters of young which can be raised while the mother feeds upon it.*

The effect of good nutrition on fertility of animals has long been recognized. As early as 1921, sows on an A deficient diet were reported to give birth to malformed offspring. Later reports describe pigs without eyeballs, with cleft palates, harehairs, accessory ears, misplaced kidneys, etc. In 1940 Warkany and his co workers were able to show that deficiency of riboflavin was important. They produced abnormalities in one litter, could prevent it in the next, produce it again at will, indicative that the diet injured the offspring rather than the mother.

Any dietary deficiency, whether it be deficiency of vitamins, minerals, protein, or total calories, will have its influence upon fertility. Vitamin deficiencies operate in various ways, as has

been pointed out under that discussion. McEster expresses the idea when he says "reproduction is not the function of the generative organs alone but of the whole organism the well being of the entire animal is of determining influence". One vitamin E is specifically designated as the antisterility vitamin and it is needed for the reproduction of *certain* animals. Its specific place in the human being is not proved its effectiveness in preventing repeated abortion having been both confirmed and denied. In addition to vitamin I, extreme deficiency of vitamins A B C or of essential fatty acids has been shown to result in sterility of animals.

One of the several important studies carried out to determine the effect of diet on pregnancy was that by Dr Harry Fibbs from the Department of Pediatrics of the University of Toronto.

Briefly a group of pregnant women found to have very poor diets were divided into two groups. One group of 120 women on poor diets and with low incomes were followed during the last half of pregnancy as controls for 90 women on equally poor diets and low incomes who were supplied with milk eggs cheese oranges canned tomatoes wheat germ and vitamin D capsules and who were instructed in the type of diet necessary for pregnancy. The observations made throughout pregnancy during convalescence and upon the baby showed a striking difference. The incidence of miscarriages premature births and stillbirths the number of infections in the mother and her general condition both mental and physical were much better in those who received the extra food. Changes in the blood of the mothers given extra food gave evidence that they were in better condition during the stress of pregnancy. The general condition of the babies born of mothers who received the extra food was much better than the condition of those born of mothers who were left on their poor diets. The incidence of illness among the babies was much greater in the poor diet group.

While it is well recognized that there are many factors in the successful outcome of pregnancy it seems reasonable that proper nutrition will insure a more optimum general condition of the mother which will possibly prevent or at least minimize the complications which occur in pregnancy. The tired depressed and physically poor women in the Fibbs study (Table 45) with a past history of a high percentage of complications were poor ob-

stetrical risks. But even in four or five months of proper feeding, this condition was greatly improved and the outcome of pregnancy was not only better than with those who were left on their poor diet, or who ate what was termed a "good diet," but resulted in a lower rate of complications than they had experienced in previous pregnancies.

Other studies on methods of evaluating the nutritional status of mothers and infants have been carried out or are in progress, data are accumulating.



Fig 56 —Photograph of two pupple weaning on the same diet, deficient in the offspring of a mother fed during in vitamins A and D and containing of puppy 2 (right) was fed on a du oatmeal as the cereal. It will be noted while puppy 1 has developed severe stationery Office from Medical Resear

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Burke has reported on studies carried out by the Department of Maternal and Child Health of the Harvard School of Public Health in conjunction with the Boston Lying-In Hospital. Earlier research dealt with 216 women and their infants. Subsequent reports were concerned with 68 younger siblings born to 57 of the original 216 women. Extensive dietary histories which gave a picture of the average daily food intake for the latter part of pregnancy were obtained from the women. The histories were carefully cross-checked to reduce all errors to a minimum.

Burke found the following in the 284 cases. "Where the diet was 'good or excellent,' 95% of the infants were in good or ex-

cellent physical condition at birth, in contrast when the maternal diet was 'poor to very poor,' 65% of the infants were in the poorest physical condition at birth (this means that the infants were stillborn or died in the neonatal period were premature or functionally immature or had a marked congenital defect) 27% were in a fair condition at birth and only 8% were

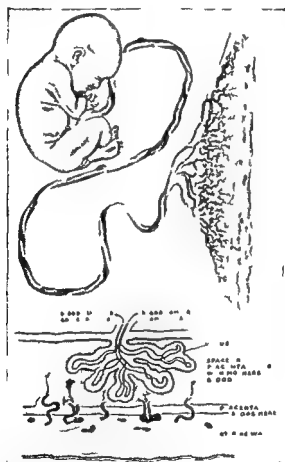


Fig. 57.—Diagrams to show the relation of the maternal and fetal circulations (From Logert "Nutrition and Physical Fitness" W. B. Saunders Co.)

in good or excellent physical condition. She further discussed the differences in birth weights and birth lengths of infants in the three dietary categories.

As a concluding thought Burke suggested that "the fetus may suffer far more quickly and with less maternal disturbance than is generally appreciated when the mother is malnourished."

This thought gives an entirely different concept to the mother fetus relationship. Many young mothers and mothers to be are of the opinion that the fetus develops normally at the expense of the mother. Instead, it is suggested that the fetus itself may suffer considerably if the mother is malnourished.

TABLE 45  
DIET IN RELATION TO COMPLICATIONS IN PREGNANCY

<i>Complications During Pregnancy</i>			
COMPLICATION		POOR DIET	SUPPLEMENTED GOOD DIET
Anemia		28.6%	16.1%
Toxemia		7.6%	3.4%
Threatened miscarriage		8.4%	1.1%
Miscarriage		6.0%	0
Premature birth		8.0%	2.2%
Stillbirth		3.4%	0
Breast abscess		3.0%	1.1%
<i>Obstetrician's Rating of Patient During Pregnancy*</i>			
		POOR DIET	SUPPLEMENTED GOOD DIET
Prenatal period	Good	64	91
	Poor	36	9
Labor	Good	76	97
	Poor	24	3
Convalescence	Good	88	96
	Poor	12	4
Whole course of pregnancy	Good	66	94
	Poor	34	6

\*The obstetrician was unaware of the diet group to which each patient belonged.

Thus the logical diet in pregnancy is the normal diet of the mother enriched to permit her to produce another life without sacrifice of herself. Table 48 includes the recommended allowances of nutrients of the National Research Council. This is compared with the allowances recommended for the 25 year old reference woman. These allowances are based on the assumption that the mother comes to pregnancy in a good nutritional state. If she is malnourished, or suffering from a conditioned nutritional deficiency, it should be corrected during the first half of pregnancy before the fetus makes excessive nutritional demands.

Table 49 includes a basic menu pattern for pregnancy and lactation. The basic diet for a 25 year old woman is used as the foundation (see Table 74), and modifications are made to meet

the recommendations of the National Research Council. This diet is lower in calories than the recommended allowances. The difference in calories however can easily be met by the addition of extra portions of the foods listed in the diet or those foods that are of concentrated caloric value.

During the first half of pregnancy there is no increase in metabolic rate and no caloric increase is necessary in fact it is undesirable if the woman's weight is essentially normal. After the fourth month more rapid fetal development calls for an increased caloric intake until just before delivery when there is 20% metabolic increase and an approximate weight increase of 15 to 20 pounds.

The diet of the pregnant woman should contain adequate amounts of protein of high biological value, milk, eggs and meat. Especially important is the calcium, phosphorus and iron intake. In regard to the vitamins, as we have already said, a deficiency of any one of them is highly undesirable. At this time supplementation of the normal diet by cod liver oil or some other source of vitamin D is necessary if normal structural development is to take place.

While during pregnancy it is important that the diet shall be adequate and the health of the prospective mother optimum, it must be remembered that health, habits of rest, exercise, bathing, serenity of spirit are all factors which may play important roles.

At no other time in life is the daily quart of milk so necessary as when the mother is carrying her child. The calcium need is increased at this time and 1.5 to 2 gm. daily is the preferable intake. This cannot be accomplished without the inclusion as a minimum of the quart of milk. In addition it will be remembered milk will contribute phosphorus and vitamins A, B, B<sub>2</sub> and protein and this quart will help protect against deficiencies of these vitamins. By including cream soups, custards, cocoa, etc. it will not be difficult to consume this amount.

The daily inclusion of meat or fish increases the level of intake of protein to the daily optimum of 80 to 100 gm. Diets in pregnancy are no longer restricted in protein to reduce kidney work. There is no sound basis for such restriction except in certain toxemias which occasionally develop. Such complications as the toxemias are outside the scope of this discussion of normal pregnancy. Protein restriction is harmful in normal pregnancy. The

inclusion of fish once or twice a week increases the iodine intake, which is desirable (see discussion of Iodine in Chapters 10 and 13), because, with the added strain of pregnancy, thyroid abnormalities may develop. Liver contains many dietary essentials and is effective in preventing the development of anemia, often a complicating condition in pregnancy. One or two eggs a day add phosphorus, sulfur, some iodine, lecithin, vitamins A, B, and D, iron, essential fatty acids, and fat in a finely emulsified form which is readily digestible.

If not contraindicated, the whole grain cereals should be used in preference to the highly milled ones. The tendency toward constipation (due to pressure of the enlarging uterus on the intestines) may be corrected by cereal roughage, and good use is made of the vitamin and mineral content of the whole grain products. For the same reason, liberal amounts of green, leafy vegetables and fruits should be consumed each day. Two servings of each should be routine procedure.

A plentiful amount of liquid, especially water, will facilitate the work of the kidneys in eliminating certain metabolic end products and should be the practice unless definitely contraindicated.

The disturbances manifested by nausea and vomiting in the early months of pregnancy result, according to one theory, from the incomplete establishment of the connection between the embryo and the mother. These disturbances are not due to disagreement of food or to digestive upset. Usually increased intake of carbohydrate and decreased intake of fat, and smaller and more frequent meals with a light breakfast before rising, will result in greater comfort. Pyridoxine in doses of 10 to 50 mg. has been used with some success in the control of nausea. If the vomiting persists ("pernicious vomiting"), medical advice should be sought.

The craving for certain foods during pregnancy should be satisfied only after basic essentials have been supplied. When the basic needs have been met, the dictates of appetite may be followed as desired, with precaution against unwanted weight change. These cravings, or chance unpleasant sights or thoughts, it must be remembered, have no effect upon the developing fetus, superstition as to "markings" of old wives' tales to the con-

tiary If it had, few children would be born physically perfect There is no nerve connection between mother and child, but only an exchange of soluble materials through the placenta and umbilical cord These two structures develop during pregnancy to supply structural material and oxygen to the fetus and for the removal of waste

About the third month of pregnancy the development of the fetus is complete, and it lies inside a closed membrane, completely filling the inside of the uterus Here, as an aquatic animal, the child lives in a world all its own, shielded and protected to the utmost degree, until delivery

### Complications in Pregnancy

Pregnancy is a normal, physiological function and under most circumstances proceeds to term without complications When abnormal conditions arise however special treatment must be instituted dietetically and medically

"Morning sickness" (a mild vomiting) appears in about 50% of all pregnancies In the usual type of vomiting little alteration in diet composition is necessary as breakfast high in carbohydrate and eaten in bed will usually offset the condition However if it persists throughout the day high carbohydrate meals, smaller in amount and eaten at more frequent intervals, may help to control the vomiting If the vomiting becomes pernicious food by mouth is withheld for twenty four to forty eight hours, and infusions of normal saline and of 5 to 10% glucose are given The total volume required will depend upon the degree of dehydration of the patient usually 2500 cc or more If a ketosis is present, insulin and glucose are sometimes given As food tolerance returns the patient should be permitted to eat what she desires, rather than to force a planned diet upon her After the acute period has passed the diet can be readjusted In the meantime, commercial vitamins and minerals may be used to prevent deficiencies

Eclampsia (convulsive seizure during pregnancy) in mild or severe form may be a complication of pregnancy Dietary control is a matter of debate Some authorities contend that protein should be sharply curtailed, others say that it should be increased, and still others maintain that it should be left at normal



tain how closely his intake approaches his requirement. With no change in clothing, the difference in weight of a baby before and at the completion of nursing is a measure of the food ingested. Other criteria of adequacy are satisfactory weight gain, happiness of the baby, and his sleeping habits between feedings.

The normal infant weighs 6 to 7 pounds at birth, doubles his weight in five to six months, and triples it by the end of the first year. There should be steady weight gain of about 4 to 8 ounces weekly, 6 to 8 ounces in the first six months, and 4 to 6 ounces in the second six months. If the mother's milk could be produced with perfect efficiency, there would be immediate need at parturition (if the child weighed 7 pounds) for approximately 350 extra calories daily in her diet, as can be seen by the calculation  $7 \text{ pounds} \times 2\frac{1}{2} \text{ ounces of milk per pound} \times \text{calorie value of 20 calories per ounce of milk}$ .

TABLE 47  
ASH CONSTITUENTS OF HUMAN MILK

	PER CENT
Calcium phosphate	23.87
Calcium sulfate	2.25
Calcium carbonate	2.65
Calcium silicate	1.27
Potassium carbonate	23.47
Potassium chloride	12.05
Potassium sulfate	8.33
Magnesium carbonate	3.77
Sodium chloride	21.77
Ferric oxide and aluminum	0.37
	100.00

Considering the normal weight gain, it is found that during the first month the daily requirement of the infant will be roughly 500 calories daily, during the second month 600 calories, during the third 700, and so on (see Chapter 21). The food requirement of an infant is roughly three times as great per unit of body weight as that of an adult.

The production of milk is not accomplished with efficiency. There is dissipation of energy and food value in the transfer of food material from the mother's diet to her milk. Therefore, more is involved than simply meeting the baby's requirement. Experimentally, it has been shown that only 50% of the food

protein is converted into milk protein consequently for every gram of milk protein the mother's diet must contain 2 gm of food protein. The protein value of human milk is variously given from 1.2 to 2.0—an average of 1.6% protein or 0.45 gm protein per ounce  $\times 17.5$  ounces of milk (7 lb  $\times 2\frac{1}{2}$  oz) = 7.88 gm of milk protein. To obtain this extra 8 gm of milk protein 16 gm of food protein must be eaten.

The precursors of the other constituents of milk are found in the mother's blood as the end products of her digestive processes. There is evidence of a vitamin loss between the mother's blood and her milk especially loss of the vitamin B complex. An increase in vitamin B complex is therefore recommended for the mother's diet. Vitamin C of the milk is dependent upon its content in the diet. Unpublished data obtained by one of us indicate that the ingestion of fruit between one and two hours before the nursing period rather than at mealtimes assures an increased level of vitamin C in the breast milk at nursing time. Only by a more than adequate intake of vitamin C by the mother can the baby be assured of his share. From a 50% increase to a doubled intake is suggested. Unless the child is receiving a fish liver oil the mother's diet should contain such a supplement to assure optimum bone development in the child. It also has a protective value to the mother herself inasmuch as some of the vitamins A and D of her food are diverted from her body use to the milk she produces.

To summarize the diet during lactation must have a caloric intake up to 50% greater than the diet at the end of pregnancy. (One calorie as milk requires approximately two calories of food.) It must also have higher protein level especially of foods having high sulfur content increased calcium phosphorus and iron and an increased vitamin intake. These requirements will be met if the diet contains liberally each day one to one and one-half quarts of milk a generous serving of meat or fish (liver twice a week) one or two eggs cheese a glass of orange or grapefruit juice (200 cc either fresh frozen or canned or the pulp equivalent) two vegetables other than potato a second fruit a generous serving of butter or fortified margarine and a cereal in cereal product both prepared from whole grain or a cereal reinforced with wheat germ or one of the enriched.

TABLE 48  
RECOMMENDED DAILY ALLOWANCES FOR 25 YEAR OLD REFERENCE WOMAN, PREGNANCY AND LACTATION  
(Food and Nutrition Board, National Research Council, Revised 1953)

WEIGHT KG (LB)	HEIGHT CM (IN)	CALORIES	PRO TEIN GM	CAL CIUM GM	IRON MG	VITA MIN A IU	THIA MINE MG	RIBO FLAVIN MG	NIACIN MG	AS CORBIC ACID MG	VITA MIN D IU
Woman, 25 year old	50 (121)	2,300	55	0.8	12	5,000	1.2	1.4	12	70	---
Pregnant (3rd trimester)		Adl 400	80	15	15	6,000	1.5	2.0	15	100	400
Lactating (850 ml daily)		Adl 1,000	100	2.0	15	8,000	1.5	2.5	13	150	400

See Table 3 for explanatory footnotes

flours or cereals. As a dietary factor not as medication the inclusion of a fish liver preparation is a wise precaution.

The increased need during lactation is indicated by comparing the values recommended by the Food and Nutrition Board (Table 48).

Lactation may be influenced by factors in addition to the basic biological limitation and adherence to a dietary regime of higher caloric protein and vitamin intake.

Adherence to this dietary should bring favorable results but it must be remembered that psychic influences have tremendous force. Freedom from worry, sufficient rest, happiness, general relaxation and good health habits are essential.

Breast feeding should be continued if possible at least until after the sixth month and may be continued until the seventh or eighth month. The exact time will depend upon a number of factors: the milk supply, health of the mother and child and environmental conditions. Weaning is preferably done gradually, over a month's period.

When the mixed feeding is being carried out the amount of food received from the breast must be determined in order to calculate the amount of supplement necessary for adequate feeding.

TABLE 49  
ADJUSTMENT OF BASIC DIET (TABLE 74) FOR NUTRITIONAL NEEDS OF  
PREGNANCY

FOOD	BASIC DIET	PREGNANCY (LAST TRIMESTER)	LACTATION
Milk whole	2 cups	4½ cups	6½ cups
Egg	1	1	1
Meat poultry fish	4 ounces edible portion	8 ounces edible portion	6 ounces edible portion
Bread and cereal whole grain or enriched	4 slices	6 slices	8 slices
Potato cooked	1 small	1 small	1 small
Vegetable green leafy or yellow	1 cup	1½ cup	1½ cup
Vegetable other	2½ cups	2½ cups	2½ cups
Fruit citrus	4 fl oz or 1 serving	4 fl oz or 1 serving	8 fl oz or 2 servings
Fruit other	2 servings	2 servings	2 servings
Butter or fortified margarine oils	3 tablespoons	3 tablespoons	3 tablespoons

These diets do not meet the recommended dietary allowances for calories. Calories may be obtained easily from additional amounts of foods listed above or other foods such as desserts, cream or concentrated sweets.

### Review Questions

- 1 To what food nutrients should special attention be paid during pregnancy?
- 2 Which of these nutrients have been found lacking in the diets of young people today?
- 3 What are the assumptions upon which a diet during pregnancy are based?
- 4 What is the modern theory in regard to protein intake during pregnancy and its possible connection with eclampsia?
- 5 Is there need for calorie increase in the diet of the mother during lactation?
- 6 Is there need for calorie increase in the diet of the mother during pregnancy? If so, what causes this increase?
- 7 Should the amount of any of the food nutrients be increased during lactation? If so, which ones?
- 8 Are there any other factors which may influence milk production?
- 9 When should the preparation for lactation begin?
- 10 What are some of the complications of pregnancy and how may they affect the diet of the mother?

### Suggested Projects

- 1 Adjust your own menus in terms of the suggested menu pattern in Table 40 for a diet in pregnancy. Do you have difficulty in including all the necessary foods in your daily menus? What are some of the ways you adjusted your menus? What is the total caloric value of your menus if you were to include the "extras" you like and the foods in Table 40? Would your weight be affected?
- 2 Interview someone you know who is pregnant. Evaluate her menus in terms of the information you have learned. List the problems she may indicate that she has in including necessary foods in her menus.
- 3 Interview a physician. Ask him (or her) about the supplementary vitamins and minerals he prescribes for his patients who are pregnant. Are these in addition to foods which will supply the amounts recommended by the National Research Council?

## CHAPTER 19

### THE FEEDING OF INFANTS

The nutritive needs of the infant are the same whether he is breast fed or formula fed. A guide for calculating the formula on an individual basis is discussed. The need for modifications of that formula and alternate forms of milk are described in detail. Foods are added to the infant's diet during the first year. Possible methods of serving these foods are suggested. The environmental aspects of feeding which are also important are described. Fitting the feeding of the infant into the daily routine of the mother so that it is a natural process whether it be formula or breast feeding is important in infant feeding.

Breast feeding of infants is the preferred method during the first six months. Rarely is there a child who cannot tolerate his mother's milk. With a cooperatively planned program by the physician and mother it has been estimated that at least 85% of women can nurse their babies for at least a few months.

Gurlee in his 1935 Chicago study found that in a series of 9,449 babies 48.5% were breast fed and in this group the mortality was 11 per thousand. In the group where there was mixed breast and bottle feeding the mortality was 5 times as high and in the completely bottle fed it was 10 times as high. Of course one must recognize the factor of intelligence and sanitation in the figures for bottle fed babies.

Breast feeding has the advantages of requiring no modification of the milk, it obviates the danger of contamination and it is less effort for the mother. It does interfere with the mother's free time and where this is a hardship to the point that breast feeding might be discontinued the use of one bottle feeding a day may be adopted. In inability to produce milk, active tuberculosis or other disqualifying condition artificial feeding must be used. During infancy whether the feeding be artificial or natural the schedule outlined later in this chapter should be observed.

As has been pointed out in the preceding chapter in the section on Lactation the approximate food requirement for any

fant can be calculated. The amount must be sufficient to permit a steady weight gain of from 4 to 8 ounces weekly after the first initial loss in weight has occurred. A slow steady gain is desirable. The best criterion of proper feeding is this steady weight gain coupled with a happy baby (one who is not restless or irritable) whose recovery from minor ailments is rapid and who has bouts of neither diarrhea nor constipation.

Complicated formulas have been used in the past when breast feeding was impractical. Today, greatly simplified formulas feed the child adequately.

As in the planning of diets for the adult certain requirements must be met. The approximate caloric need is of first consideration and for the normal growing infant is indicated below.

Murlin\* in discussing the normal processes of energy metabolism emphasizes the multiplicity of factors concerned in building up the energy requirement of an infant (Table 50).

TABLE 50

Basal metabolism	60 calories per kilogram
Activity metabolism (12-40% of basal)	7-240 calories per kilogram
Loss by feces (10-15% of basal)	60-90 calories per kilogram
Dynamic action (10-20% of basal)	60-120 calories per kilogram
Growth (10-20% of basal)	60-120 calories per kilogram

\*Murlin. Inocrinology and Metabolism. D. Appleton Century Co.

At the White House Conference on Child Nutrition in 1939 the total caloric intake of normal growing infants of different ages was averaged from findings in the literature in terms of need for twenty-four hours as indicated in Table 51.

The caloric requirement is roughly  $2\frac{1}{2}$  to 3 times that of the adult on a weight basis. This obviously is due to the extremely high growth rate. The child on the average doubles his birth weight in 5 months and triples it by the end of the first year during which time he has grown 8 to 10 inches in height.

In the first weeks of life the need is 120 to 100 calories per kilo per 24 hours; at 6 months 110 to 100; at 1 year 100 to 80, etc. Assuming a baby of average birth weight of around 3.4 kilo ( $7\frac{1}{2}$  pounds) and assuming normal development and need the total rough caloric requirement for a 24-hour period will be that shown in Table 51.

TABLE 51

AGE	CALORIES
1 month	500
2 months	600
4 months	700
6 months	800
9 months	900
1 year	1,000
2 years	1,200

It must be remembered that *children differ*. They cannot be fed from a set pattern. Intelligent interpretation of specific needs is one of the secrets of successful feeding.

The second consideration is the **protein level**. The protein requirement is directly proportional to the growth rate. (See Table 52.)

TABLE 52

RECOMMENDED DAILY ALLOWANCES FOR PROTEIN, EXPANDED FOR THE GROWING PERIOD

SUBJECT	AGE	PROTEIN IN GRAMS*			% OF DIETARY CALORIES AVERAGE
		TOTAL 1	PER KG 2	PER LB 3	
Premature†	1 week to 1 month	43 per Kg	60.44	27.20	17
Premature†	1 week to 1 month		50.44	23.20	15
Premature	1 to 3 months		44.33	20.15	13
Full term	2 days to 3 months		44.33	20.15	13
All infants	4 months to 1 year		40.30	18.14	13
Toddlers	1 through 3 years	40	(42.29)	(19.13)	(13)
Preschool	4 through 6 years	50	(32.25)	(15.11)	(13)
School	" through 9 years	60	(26.21)	(12.10)	(12)
School	10 through 12 years	70	(22.18)	(10.08)	(11)
Youths, female	13 through 15 years	80	(18.15)	(8.07)	(11)
Youths, male	13 through 15 years	85	(20.17)	(9.08)	(11)
Youths, female	16 through 20 years	75	(16.14)	(7.06)	(13)
Youths, male	16 through 20 years	100	(21.17)	(10.08)	(11)

\* Nutrition  
uses in  
nces in  
e basis  
Wood  
ces)

† Premature infants weighing 600 grams and over

Examination of the composition of human and cow's milk (Table 46) indicates roughly a double amount of protein in cow's milk. In the past modification included dilution of cow's milk to half value in order to bring this component down to a comparable protein level. This is no longer the practice. The



two proteins are different in structure. Proteins of milk are of two kinds: lactalbumin (whey protein) and casein or curd protein. Lactalbumin has been thought to have greater nutritive value, probably due to its high cystine (a sulfur containing amino acid) content. The protein of human milk is roughly 60% lactalbumin, cow's milk but 15%. Whether or not this is the complete answer is not clear, however, the fact remains that infants fed a higher level of protein in the form of cow's milk do better than those whose protein percentage is that of human milk. (Recently, experimental work has been reported suggesting the two milk proteins are of equal value for maintenance of the normal adult. This needs confirmation and extension into other types of use.) The customary level of 2 to 2.5 gm of protein in the form of human milk and 3.5 to 4.5 gm when fed as cow's milk is satisfactory (or, roughly, twice as much when protein is from bovine sources). The figure, 4 gm protein per kilogram, is easy to remember. This is the amount of protein supplied by  $\frac{1}{2}$  cup of milk (32 gm per quart is approximate value). The value of 4 gm of protein per kilogram represents not far from the 10 to 15% of the total caloric level suggested for adults.

$$3.4 \text{ kilo baby} \times 4 \text{ gm protein per kilo} = 13.6 \text{ gm protein}$$

$$3.4 \text{ kilo} \times 120 \text{ calories per kilo} = 408 \text{ calories}$$

$$13.6 \text{ gm protein} \times 4 \text{ calories per gm} = 54 \text{ protein calories or 13\% of the caloric need}$$

The foregoing, Table 52, taken from Levine's discussion of "Protein in Pediatrics,"\* tabulates the range of protein allowances at different age levels. The range is from 11% in the teen ager to 17% for the premature infant.

The fat in the diet of the infant supplies from 30 to 40% of the caloric need. Were it not for this concentration, the child's caloric need would have to be met by too great bulk. When intolerance to fat exists the level may be reduced to 20%, but unless absolutely necessary a level below this is borderline for adequacy of fat soluble vitamins and essential fatty acids. The fat level of milk from a mixed herd is approximately 3.5%. Such milk is preferable to that of higher fat content (Jersey, Guern

\*J. A. M. A. 125: 283 1945

sey) On a weight basis this is calculated to be approximately the same as protein—4 gm fat per kilogram of body weight

The fat of human milk is in the form of finer globules than that of cow's milk. Homogenization, evaporation and drying accomplish the same effect, hence such milks are somewhat more easily digested.

The carbohydrate caloric proportion is approximately 50% of the total. Milk alone with its carbohydrate content at a 5% level would not be sufficiently high calorically to yield this percentage of calories. Since human milk has 2% more carbohydrate than cow's milk, it is logical to supplement by this means. Usually 3 to 5% carbohydrate is added, making the formula milk 8 to 10% sugar. The type of sugar added is a matter of preference.

There is much discussion as to which sugar is best in infant feeding. As an editorial in the *Journal of the American Medical Association*† once stated: *'The 'styles' in nutrition to which children are subjected in the earliest periods of life have changed from year to year, sometimes in almost a bizarre manner.'* Lactose, sucrose, maltose, dextrose and dextrose maltose have all been recommended from time to time by means of skillful advertising. The question of digestibility and absorption, as well as the caloric value and the cost, must be taken into consideration in making a choice. The chemical structure may be of importance metabolically. For instance, dextrose is blood sugar, while galactose is a component of the fat constituent of nervous tissue (see Chapters 3 and 4). It is conceivable that sugars which require breakdown before utilization and are therefore slower of absorption may produce diarrhea. On the other hand, this slower absorption might facilitate better deposition of glycogen, or other factors of physiological use. These arguments are used for and against the several sugars. Unfortunately, prior to the twentieth century, when lactose was in general use, digestive upsets were attributed to it and several clinical experiments were conducted which were interpreted to prove that lactose was toxic. Today we know that it is not and that up to 17% lactose can be used with entire success in the infant formula. Lactose would not be the natural sugar of milk if it were harmful to the young of any species. Nature would hardly make such a mistake.

But some prejudice against lactose still exists today. Digestive upsets and failure to obtain response on a formula should not be attributed to the one factor of the sugar padding. The apparent disadvantages in the past were probably due to lack of proper sanitation and pasteurization. Other ingredients or actual infection, either within or without the gastrointestinal tract, must be considered.

There is difference in the density of sugars and the volume for a given weight varies (Table 53).

TABLE 53

1 ounce of cane sugar equals 3 level tablespoonfuls
1 ounce of corn syrup equals 2 level tablespoonfuls
1 ounce of lactose equals 3 level tablespoonfuls
1 ounce of Dextrin Maltose equals 4 level tablespoonfuls
1 ounce of these sugars equals 120 calories (4 cal./gm.)

The popular choice of sugar today is corn syrup, and the usual addition of corn syrup is roughly 5%. Karo corn syrup is a mixture of sugars. Its composition is 50% dextrin, 23.2% maltose, 16.0% dextrose, 6.0% sucrose, and 4.0% invert sugar. It is economical, easily handled, and well tolerated.

Dark cane molasses, with its appreciable iron content, yields good amounts of vitamin B<sub>6</sub>, some pantothenic acid, and some vitamin B<sub>2</sub>, and should prove a satisfactory vegetable sugar. It is the crude sugar of the sugar cane. The green label brand of Brier Rabbit Molasses contains 1 mg. of available iron per tablespoonful. Brown sugar and molasses are mildly laxative and, as such, may be of value.

A simple and satisfactory starting formula calculation is one in which fluid whole milk (or properly diluted evaporated or dried milk) is fed at 14% of the baby's body weight and with sugar added at approximately a 5% level. (See Table 54.)

Should this formula not prove satisfactory, adjustments can easily be made.

One tall can of evaporated milk (13½ oz.) diluted with an equal amount of water may be considered roughly equal to one quart of fluid milk as is one cup of powdered milk made up to a one quart volume with water.

The preparation of the formula in the manner suggested above assures the child of an adequate water intake. Water is

very important in the diet of a child. It should be supplied in amounts equal to 10 to 15% of the child's weight (varying of course with weather, which influences loss). The 34 kilogram, or 3400 gram (7½ pound), child will have a need of from 340 to 510 cc water daily. The fluid level of 476 cc is sufficient.

Dehydration is always a serious condition but especially so in the infant. The onset may be insidious; the ultimate effect dramatic and tragic. Water is an integral part of every body cell. None can continue to function normally in the presence of inadequate water. The infant has been an aquatic animal before birth. He is especially prone to depletion. When a formula is prepared without the use of fluid milk—from evaporated or dried milk—the amount of water added in its preparation should be such that the child's water need is covered.

TABLE 54

## FORMULA CALCULATION DATA

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14% of 3400 gm (34 kg) = 476 cc milk
milk has caloric value of approximately
0.7 calories per cc $476 \times 0.7 = 333$ calories from milk
The infant's need is 34 kg $\times$ 120 cal per kg
$34 \times 120 = 408$ calories
$408 - 333 = 75$ calorie deficiency
5% of 476 cc = 23.8 or 24 gm sugar
$\frac{1}{2}$ gm $\times$ 4 calories per gm = 96 calories from sugar
$96 + 75 = 171$ calories a leeway of 21 calories
(4% sugar would have yielded 176 calories)

---

That this is a good starting point can be shown by determinations of the calorie ratio:

476 cc milk at 3.5% average protein yield = 16.56 or 17 gm of protein
17 gm 34 kg = 5 gm protein per kg
17 gm $\times$ 4 cal per gm = 68 protein calories
68 calories is approximately 15% of 430 calories
Similar calculation indicates yield to be
13 gm fat—approximately 5½ gm per kg—40% of calories
48 gm carbohydrate—approximately 14 gm per kg—45% of calories

---

This formula satisfies the water need—water at 10 to 15% of body weight:

10% of 34 = 340 cc water
15% of 34 = 510 cc water

The fluid level of 476 is sufficient

The composition of this formula is readily adjusted by additional water, altering the sugar level, removing some of the cream from the milk, adding powdered milk, or, in rare cases the addition of cream

In calculating the formula it is important that the optimum weight of the infant be used rather than the actual weight if this is low. The nutritive needs of the underweight infant are as great as those of the normal—he has the same organic muscle mass, only adipose tissue is lacking. Mild inadequacy results in slow growth and development, irritability, decrease in resistance to infection, specific deficiency conditions, anemia, and so forth.

Prolonged undernutrition is a serious matter. The caloric outgo is greater than the intake and body tissue is drawn upon. The carbohydrate stores are first utilized, then fat stores are drawn upon. When fat is burned to a point representing 60% of the total calories, the ability to oxidize it is reached and ketosis results.

When the subcutaneous fat is gone, the infant becomes emaciated and the protein of muscle, blood, and other organs is drawn upon. The blood protein falls, the blood volume is decreased, circulation is impaired, and all organs are affected. The temperature falls, edema results, the heart becomes weak, and the infant may go into shock. Diarrhea and vomiting are not infrequent.

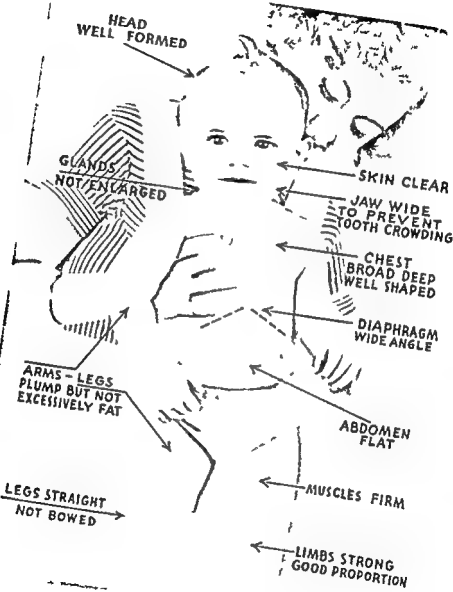
TABLE 55

## STRONG MEMORIAL HOSPITAL SCHEDULE

AGE	MILK OZ	CORN SYRUP TBS	CALORIES
Under 1 mo	15	1½ (or ½ oz)	390
1 mo	18	2	600
2 mo	22	2½	710
3 mo	26	3½	860
4 mo	28	3	920
5 mo	29	2	940
6 mo	30	2	840
7 mo	31	1	740
8 mo	32	0	640
9 mo	32	0	640
10 mo	32	0	640
11 mo	32	0	640
12 mo	32	0	640

Whole pasteurized milk is 14 to 12% of body weight plus 5% of corn syrup.  
Sugar is decreased around the sixth month.

# FEEDING OF INFANTS



Fruit (or water Exchange)

### Starvation is extreme undernutrition

The requirements of undernourished children are higher than those of the normal; an allowance for complete recovery must be included.

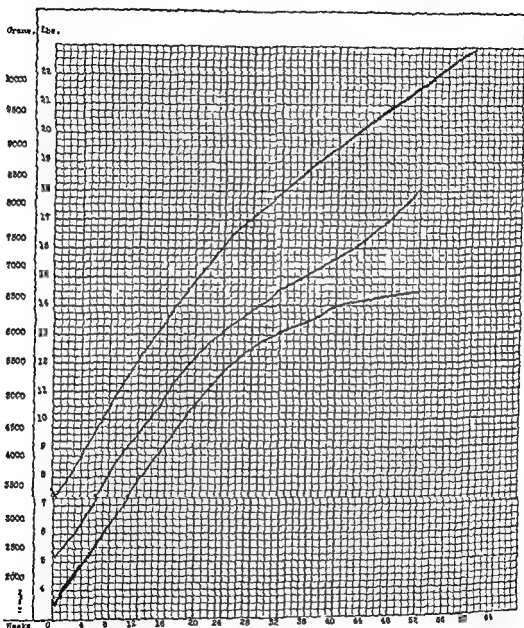


Fig 59 — Average weight curves of infants during the first year of life. (After Camerer from Marriott Infant Nutrition)

As the child grows older, milk, while greater in actual volume, is less in relation to the child's weight. The amount of sugar

decreases as other foods add their calories to the total. See Tables 54 and 55.

If the vitamin and mineral constituents of a pint of milk are checked against the child's needs it will be seen that the suggested basic formula is adequate except for vitamins D and C and for iron. A fish oil and orange juice or a commercial source of vitamin C are introduced into the child's diet in today's practice before the child leaves the hospital. As for the iron, nature has provided for the low iron level of milk. As was pointed out under the discussion of iron and pregnancy, iron is stored in the liver of the fetus in sufficient quantities to carry the child (or any other mammal) through the normal nursing period.

When evaporated milk is used it must be remembered that it is essentially double strength due to water removal. 7% protein, 7.9% fat and 10% carbohydrate. Water must be added as diluent.

Special products of which Lactum is *but one* may also be used. This is an evaporated whole milk Dextrin Maltose formula adjusted to the needs of a full term infant. The caloric ratio is 16% protein, 34% fat and 50% carbohydrate. In usage some physicians prefer to start with a 1:2 (milk:water) dilution for the first week with a shift over to the standard 1:1 dilution thereafter.

If cost is not a factor one of the prepared foods such as Similac or another similar product of which there are many may be used. Similac is a modified milk product especially prepared for infant feeding made by homogenization of tuberculin tested cow's milk (cream modified) from which part of the butter fat has been removed and to which has been added lactose, coconut oil, corn oil, olive oil, coconut butter, fish liver oil, concentrate, ascorbic acid and thiamine.

Diluted with an equal amount of water the composition is

Fat	3.4%
Carbohydrate	6.55%
Protein	1.72%
Minerals	0.38%
Moisture	87.95%
Calcium	0.07%
Phosphorus	0.05%
100 calories per oz.	



One quart so diluted contains

Vitamin A	2,500 USP
Vitamin D	400 USP
Thiamine	0.25 mg
Riboflavin	0.96 mg
Ascorbic acid	50 mg

The 16 oz (pint) can may be used with any volume of water desired. Such a product reduces formula preparation work to a minimum, supplies the need for cod liver oil in early months and is protective against iron deficiency. From this standpoint the cost, approximately three times that of a similar can of plain evaporated milk, is not as great as it seems. Such formulas, it must be remembered, usually require supplementation with vitamin C.

The use of acid milk, protein milk, and of milk substitutes may be necessary. The acid and protein milks are sometimes used in digestive disturbances, and the milk substitutes are used in allergy. The acid milks are usually partly defatted or skimmed milks which have been acidified by lactic acid, citric acid, orange juice, or lemon juice. The addition of the acid produces a finer and therefore a more digestible curd. To a thoroughly chilled formula, 85% lactic acid may be slowly added with constant stirring in the proportion of 4 cc to 1 quart. This results in a fine suspension of curd which does not settle out on standing. Too much acid, too warm milk, or too rapid addition of the acid, results in separation of the curd and whey. If great excess of acid is added, the curd is redissolved. Orange juice in the amount of 2 oz to 1 quart of milk will produce practically the same fine curd.

Protein milk is milk enriched with protein. It can be obtained commercially or it can be prepared at home by adding curd to whole partly defatted or skim liquid milk. The curd may be prepared by coagulating whole milk with commercial rennin (1 quart of milk at 100° F to which is added 1 Junket tablet). The curd is collected and drained through cheesecloth and then rubbed through a fine strainer into lactic acid milk (1 pint). It is then strained again, and the volume is made up to 1 quart with boiled water. A higher protein level may be obtained by

the addition of Case (calcium caseinate) or powdered skim milk. Milk may be reinforced with powdered milk to a double or triple protein content.

Occasionally a baby will show sensitivity to cow's milk and substitution is necessary. Sometimes such a child will tolerate evaporated milk or hypoallergic milks which have had their protein structure altered by heating. If neither of these suffices soybean milk is probably the most satisfactory substitution. Commercial soybean products such as Sobee are available or the milk may be prepared from the soybeans at lesser cost. The protein of the soybean (glycinin) is of high biological value in contrast to most vegetable proteins. The soybean milk is prepared by adding to the soybean meal more than enough water to saturate it. This is allowed to stand for two hours and then five times the volume of boiling water is added and the mixture is boiled for ten minutes with constant stirring. It is then filtered through a fine cloth. The fluid obtained looks not unlike cow's milk and has a composition of approximately 4% protein, 18% fat and less than 1% carbohydrate. The addition of 2% vegetable oil (such as Wesson or olive oil) and 5% carbohydrate (lactose, glucose or cane sugar) makes this a satisfactory milk substitute.

The formula of Sobee powder is

Soybean flour	61%
Olive oil	19%
Arrow root starch	9%
Dextrin Maltose	6%
D calcium phosphate	4%
Sodium chloride	1%

By dilution it becomes 28% fat, 4.2% protein, 4.1% carbohydrate and 1% salt.

Mull Soy, another soybean preparation (an evaporated liquid) has a composition of

Soybean flour
Soybean oil
Dextrose
Sucrose
Calcium phosphate
Sodium chloride
Calcium carbonate

When diluted according to directions, it yields

Protein	30 %
Fat	39 %
Carbohydrate	44 %
Ash	10 %
Calcium $\text{CaO}$	0.18%
Phosphorus pentoxide	0.25%
Water—20 cal per ounce	87.7 %

The actual preparation of the formula is important. If pasteurized milk is used, the milk is poured from the bottle (after careful outside cleansing) into a pan and brought to boiling with constant stirring, and held for three to four minutes at boiling point. It is then cooled quickly and the scum removed. It is diluted at this point with cool boiled water, if dilution is necessary, sugar having been added to the water. After thorough mixing, the formula is poured into clean, sterile bottles in correct amounts for single feedings, sealed, and stored in a cold place until just before feeding time, when a bottle is removed and warmed to body temperature.

If evaporated milk is used, it need not be brought to boiling as evaporated milk is already sterile. The sweetened, sterile water is added to the milk as it comes from the can, and stored in bottles, as above.

If dried milk is used (Klim), 1 part of the powdered milk to 4 parts of sterile, sweetened water is mixed and stored. It has the advantage of supplying adequate calories at any liquid level.

Directions for acidification or protein reinforcement have been given earlier in this chapter.

Bottles and nipples should always be washed thoroughly, immediately after each feeding.

More recently, *terminal sterilization* of the formula has gained in popularity. Details for this method will be found in the Appendix.

The lives of many premature infants are saved today by the care they receive. When hospitalized they are isolated in air conditioned rooms maintained at constant temperature, and are fed with great care. In most instances the baby is too weak to take the breast or the bottle, and a medicine dropper or other type of feeder, is used. Breast milk from the child's mother, or from another source, is usually available. It is now possible

to buy frozen breast milk. If it is not available a modified milk is prepared. Usually only water is given during the first twenty-four hours. Thereafter, at two to three hour intervals, dilute milk is fed, a dilution up to 1 part milk and 3 parts water the first few days is tolerated, with increasing percentage of milk up to the usual formula or a 5% glucose solution, may precede any milk for the second 24 hour period. At the end of this time milk may be gradually added to the glucose. Acidified milks are also frequently used for "the premature" as are dried milk formulas which have the advantage of high nutritive value and low bulk by simple decrease in dilution. The recent use of purified meat has proved useful as a formula addition.

Levine\* has suggested formulas for feeding the premature baby (Table 56). They serve as well to demonstrate range and possibilities for formula prescriptions.

TABLE 56

FORMULAS FOR FEEDING PREMATURE INFANTS PER KILOGRAM OF BODY WEIGHT  
AND IN PERCENTAGES OF DIETARY CALORIES

MILK	TYPE	CC	SUGAR WATER		PROTEIN		FAT		CARBOHYDRATE		CALORIES
			GM	CC	GM	CC	GM	CC	GM	CC	
Human		180		0	2.2	7	6.7	50	12.9	4.3	120
Cow's											
Whole		111	13	50	3.5	13	3.5	27	17.8	6.0	120
Lactic acid		140	6		4.8	16	5.5	41	12.9	4.3	120
Evaporated		0	6	50	4.8	16	5.5	41	12.9	4.3	120
Low lactic acid											
*Kimmel											
(Alacta)		18	11	10	6.0	20	2.2	16	19.4	6.1	120

Other conditions arise in which diet modification is temporarily necessary. Vomiting frequently accompanies a minor upset. This does not necessarily mean that food should be discontinued but that the temporary decrease of total intake may be helpful. Plenty of water should be offered and the child under no circumstances should be forced to eat. If diarrhea occurs the food should be stopped and water given. Feeding should be resumed slowly. The diarrhea may result from a formula too high in carbohydrate or too high in fat. In either case permanent adjustment must be made. Conversely constipation may sometimes be corrected by increase in these food constituents.

\*J. A. M. A. 128: 283, 1945

A diet high in sugar and low in protein is a laxative diet. One low in sugar and high in protein tends to be constipating. Sugars, in general, have a laxative effect, some more so than others. Dextrose is highly fermentable, but is absorbed quickly in the upper part of the intestinal tract and has, therefore, the least laxative effect. Lactose is slowly broken down, is slowly absorbed, offers the greater chance for bacterial decomposition, and has the highest laxative effect. The malt sugars vary considerably, depending on their composition.

Undernourishment in an infant may be due to an ill-adjusted formula, insufficient intake, or to metabolic disturbance. Therapy consists in determining the cause and making the necessary adjustment. The overweight baby may need a decrease in fat or carbohydrate intake, or in both.

Any digestive upset which is more than transitory, and which does not clear with simple adjustment, requires the attention of the doctor to determine the basic, physical cause.

Equal division of the formula into the approximate number of bottles is routine unless the child indicates a preference for more or less at any meal. Starting with six bottles of  $2\frac{1}{2}$  to 3 ounces each, adjustment is made in accordance with total volume and number of meals until at one year it has become 3 bottles of 8 ounces each. (For example see Table 57.)

TABLE 57  
AVERAGE NUMBER OF INFANT FEEDINGS PER DAY

AGE (MONTHS)	VOLUME OF EACH FEEDING (OZ.)	NUMBER OF FEEDINGS IN 24 HOURS
1	3	6
2	4	5
4	5	5
6	6	4
8	7	4
10	8	3
12	8	3

The formula is increased in volume and strength depending on growth and satisfaction of the infant, the digestibility and utilization as indicated by consistency and number of stools and gastric effect. Approximately 50 to 100 calories will need to be added each month—or by increasing the milk approximately

$1\frac{1}{2}$  ounce for every 5 ounces in weight gain, leaving the sugar value unchanged

No two babies react exactly alike to the same feeding plan and no definite rules can be set up. Common sense must be used in making adjustments. If a baby takes from choice a little more than the ounces that may have been calculated at one feeding, and a little less at another, there is no reason why he should not do so.

In the "self-regulating" schedule now being used by some pediatricians both the time interval and the amount consumed is left entirely to the preference of the child. The child is fed when he cries—presumably because he is hungry. Usually after a few weeks a fairly constant schedule as to both time and quantity is established by the child. One child for example, departed from the widely used 6 10 2 6 10 2 feeding program to a consistent one of 5 9 12 5 8 in the first weeks of life.

A plain milk formula should always be supplemented with orange juice and cod liver oil from the first month.

Cod liver oil may be given as early as the end of the first week. The amount given will depend upon the potency of the oil used, potency varies widely. One fourth teaspoonful is approximately 1 gm. of oil and yields 1500 USP units of vitamin A and 150 USP units or more of vitamin D in a good grade of oil. Dosage is preferably begun with 10 drops the first day and increased by 10 drops each day until the quarter teaspoonful dosage is reached. At 2 months the dosage should be slowly increased to a half teaspoonful daily, at 4 months to three fourths teaspoonful, at 6 months it is frequently increased to a full teaspoon. The teaspoon level yields about 7,500 to 10,000 units of vitamin A and 750 to 1,000 units of vitamin D. This is roughly double the recommended need for the child.

When concentrates are used, a standardized dropper accompanies the bottle. This dropper yields approximately 50 drops to the dropper. Since concentrates are roughly 25 times as potent as the fish oil dosage is less. Roughly, one drop is equivalent to 1,000 IU vitamin A and a proportionate amount of vitamin D. Dosage, therefore, is from 3 to 7 drops daily, again a gradual increase in number of drops from one to maximum desired is preferable to immediate use of the maximum amount.

Orange juice may be added at the end of the second or third week. From one teaspoonful of juice a slow increase may be made until 1 ounce (2 tablespoonfuls or 6 teaspoonfuls) is being given by the second month. Fresh, frozen, or canned orange juice are equally satisfactory. At the third month 3 tablespoonfuls should be given, and at the fourth month 4 tablespoonfuls etc. (See Table 58). Six tablespoons or 3 ounces, equivalent to approximately 50 mg vitamin C, may be continued through childhood. If the juice is not well tolerated, tomato may be substituted, but twice or, better, thrice the amount must be given. Four times as much is required if pineapple juice is used. Supplementation by commercial ascorbic acid must sometimes be made if a deficiency of vitamin C is to be prevented. Too great a bulk of fruit juice may displace other dietary essentials, and this must be guarded against.

Pediatricians differ in the order in which they recommend additions to the diet, and the babies do equally well. The suggestions below represent *only one order* which may be used. Especially is this true in regard to meat, egg, and wheat. The child's own need or response may also be an influencing factor.

Cereals may be given in the second or third month. Any well cooked cereal may be used, if it is strained to remove coarse particles. Long, slow cooking (1 to 1½ hours) in a double boiler to soften the starch grains is important (see discussion under Cereals, Chapter 3). Salt should be added to the cooking water to bring out the natural sweetness of the cereal and to insure palatability without the addition of sugar. The cereal may be thinned at the time of serving with some of the formula. One teaspoonful twice daily, with gradual increase until at 5 months the baby takes 1 tablespoonful twice daily, at 6 months 2 tablespoonfuls twice daily, and at 9 months 4 tablespoonfuls twice daily, is a satisfactory schedule of feeding. Due to the sensitivity which some babies show to wheat some physicians withhold wheat cereals until the child is approximately 6 months old.

**Egg yolk.** At the age of 3 months egg yolk from hard cooked egg may be added to the baby's diet if this is the practice of the attending physician. Again the possibility of allergy causes some to withhold egg until after the first six months. The reason for the early inclusion of egg yolk is to compensate for the low

iron content of milk, and so prevent the occurrence of anemia. Beginning with a quarter teaspoonful of egg yolk, the amount should be increased gradually until the entire yolk is taken. Or, if preferred, the yolk may be made into a custard, using formula as the milk, and the custard may be fed separately or added to the formula. From 1 to 4 eggs weekly may be given during the first year.

**Vegetables** are usually fed at the end of the third or at the beginning of the fourth month. They should be strained until the end of the first year. After the first year they should be served as diced vegetables. The usual directions for cooking vegetables, i.e., in a small amount of salted boiling water, should be followed. The cooking water may be used to moisten the strained vegetables. As usual, the feeding starts with one teaspoonful and is increased until 3 to 4 teaspoonfuls are taken at 6 months. Butter or margarine in small amounts may be used as seasoning. Care should be taken that new vegetables are not added to the list too rapidly. Sufficient time should be allowed between additions to make sure that no allergic response will develop from the new vegetable.

**Fruit** is added next. At 5 to 6 months of age a child may have cooked, strained fruit daily—apricot, peach, prune, apple, plum, or pear. Baked or mashed raw banana may be given. The amount of fruit may be increased to 3 or 4 tablespoonfuls daily by the end of the first year.

At about 7 months the child may munch on dry toast (Melba toast) or Zwieback. Children differ in their ability and desire to chew solid food.

**Meat** is a matter of controversy, until recently, it was usually added in small amounts at around 8 months, beef, lamb, turkey, chicken, and liver, carefully broiled or roasted and finely chopped. More recently, entire meat preparations in both puréed and chopped form—beef, veal, lamb, pork, beef heart, and beef liver—have become available. These not only have been effectively used in the early months of life, but when added to the formula of the premature baby are reported to improve progress. Dr. Jeans thought "meats appropriately prepared may be fed at any age." Again, small amounts are fed at first (one teaspoonful), and one variety is fed for a sufficient length



of time to rule out allergy. The amount is increased gradually until by the end of the first year 1 ounce (2 tablespoonfuls) is taken. Meat is alternated during the first year with egg—meat three times weekly and egg yolk four times weekly.

TABLE 58

To tabulate the foregoing, for convenience, the menu might be

*At 4 Months of Age*

6 A M	11 oz milk
8 A M	2 oz orange juice
10 A M	1 tbs cereal 6 oz milk cod liver oil
2 P M	egg yolk or vegetable 6 oz milk
6 P M	6 oz milk
10 P M	6 oz milk

*At 6 Months of Age*

6 A M	7 8 oz milk
8 A M	2 oz orange juice
10 A M	1 tbs cereal 7 8 oz milk cod liver oil
2 P M	3 tbs vegetable egg yolk 7 8 oz milk
6 P M	1 tbs cereal 7 8 oz milk 1 tbs fruit cod liver oil

*At 10 to 12 Months of Age*

7 8 A M	2 3 tbs cereal served with part of milk— balance of 8 oz served in cup
Noon	2 tbs meat 2 3 tbs vegetable 2 3 tbs simple pudding piece crisp toast 8 oz milk
Mid P M	3 oz orange juice with cracker
5 30 6 30 P M	3 tbs cereal (or vegetable soup) 3 tbs fruit 8 oz milk

The fish oil or concentrate may be given at any convenient time



Thus, by the end of the first year, the child's diet is complete and further changes will be minor

The time of weaning from the breast, as pointed out in Chapter 18, will probably be in the third quarter of the first year, unless premature weaning is found necessary. It is desirable to wean a child directly to a cup rather than to a bottle. Alternate breast feeding and cup feeding as a means of weaning is helpful in the establishment of future eating habits.

A feeding schedule is important for the sake of the mother's routine and habit formation in the child. However, adherence to any rigid schedule in the early weeks of life is being abolished by many pediatricians. The child who is allowed to adjust his preferences in time and amount, rather than having these set forth for him, is usually the happier child. In the first weeks of life the child will usually be fed *approximately* every four hours around the clock. On a four hour schedule the time for feeding is usually 2, 6, and 10 o'clock in the morning, and 2, 6 and 10 o'clock in the latter half of the day. *The actual schedule will depend on the convenience of the mother and the preference of the child. The baby must not disrupt the family life, he should take his place and add to the family's pleasure.* For the sake of convenience however, such a time plan will be followed here.

By the end of the first month, or perhaps the second, the feeding coming at 2 o'clock in the morning is omitted. This may be done as soon as a satisfactory weight gain is established. Most children will voluntarily omit this meal once the need for it ceases. Near the end of six months, the 10 o'clock feeding at night may be omitted, depending on the condition or the desire of the child.

Cod liver oil or fish oil product may be given after any of the feedings, first as one dose, and later when the amount is increased as two doses if desired.

Orange juice or other source of vitamin C is usually given between meals at about 8 o'clock in the morning. It may be given alone or it may be diluted slightly with water if desired. For some babies it may be wiser to give the orange as part of a meal instead of on an empty stomach. Some babies are apparently sensitive to the organic acidity of the undiluted orange juice and may "spit it up." Also as with other foods allergy may be present. Care must be used in expressing the juice from

the orange. The oil in the skin may have an irritating effect on the baby's tender skin. At times this irritation may be mistaken for an allergy. Careful wiping of child's mouth after fruit juice feeding or any feeding is important.

The cereal when added is fed at 10 a.m. and later as more is given also at 6 p.m. The vegetables and egg or meat are added at 2 p.m. and thus the egg and vegetables become the forerunner of a noon dinner. The fruit next increases the supper meal at 6 p.m. and the basis for the three meals a day is at last established.

*Exact quantities of food cannot be planned to meet the child's appetite.* Judgment must be used in quantity of serving. A normal healthy child will satisfy himself within a reasonable time limit without force or coaxing if moderate quantities of mildly but palatably seasoned, reasonably attractive food is served at the proper temperature. Fussiness over quality of food is undesirable but the child is entitled to good meals. He will learn to like more foods if care is used in their preparation.

Coaxing a child to eat is psychologically bad and should not become a habit.

At the end of the first year the child on a three-meal a day schedule should be eating his vegetables, fruits and cereals unstrained; he should be eating dry, crisp toast, meat and egg and drinking milk, orange juice and water from a cup.

Water, boiled and cooled, should be offered between meals throughout the day, especially if the day is warm.

The problem of infant and child feeding is an ever present one and one upon which many have written. One of the most logical dissertations heard on the subject was by Dr. Aldrich when he talked about *Ancient Practices in a Scientific Age*. He discussed the effect of the impact of the new techniques in baby care on the child's ancient mechanism for in the newborn child is a living replica of the first individual born so many centuries ago. In the training process the child is under the compulsion of two forces. The first is the drive to grow according to his preordained pattern—physically, emotionally and mentally. The second is the authoritative routines of a scientific age which among other things tell the child when and how much to sleep and to eat. Thus frequently results in conflicts which are not really the baby's fault.

The newborn baby is born with reflexes which are concerned with the actual getting of food—rooting, sucking, swallowing and satiety reflexes. The first reflex to come into play is the one which causes the child to root—to move his head when he smells food in an effort to find its source. If one cheek is touched by a smooth object he will turn his mouth toward that object and open it in anticipation of grasping the food. Pressure applied to a baby's head in an effort to guide him immediately arouses a feeling of displeasure in the child. To add to his discomfort it may seem necessary to "rouse" him by any of the little tricks used for that purpose. Most newborn babies are drowsy as an aftereffect of the sedation administered to the mother. All of this takes place at a time suited to his planned program, not his desire for food, hence, a pleasurable connection between hunger and the ingestion of food may not immediately develop as Nature intended it should be. If for the first few days of life it is possible to permit the child to eat in response to hunger, to let him root for his own food, even though he dozed a bit, a worth while association between hunger, eating, and pleasure might be developed. Once this is established, it would take but a few more days to gradually introduce a routine.

The hunger appetite mechanism fares differently in the modern hospital or under a "scientific" regime. The baby's rhythmic hunger pains are completely ignored in his schedule for feeding. As Dr. Aldrich expresses it, the newborn baby who wakes up with a stomach ache and announces his epigastric crises by shrieking cries does not meet with the response Nature intended for him. Instead of being picked up and given something to eat too frequently he is forced to wait until the clock on the wall moves around to the approved hour, at which time, sleeping or screaming, he is picked up and made to eat. A slow transition from the natural way to a set program may prevent later feeding problems. Once the happy association is established between hunger and food, and between eating and food, it will carry over into later life.

By careful watching rather than by date, the child should be introduced to thick foods. When the lips open and the tongue actively takes nourishment back so that swallowing is easy, is the logical time to offer foods which are of thicker consistency.

than milk. When the child makes chewing motions, lumpy or solid foods should be given—not before and not later.

If a mother observes her child carefully and intelligently, she will find that automatically, if he is well, he will sleep through first his 2 AM and then his 10 PM feeding, and he will shift his nap time from morning to afternoon at just about the accepted time to go over onto the three meal schedule. To let these 12 adjustments be natural ones is certainly preferable to forcing a change prematurely. Babies, Dr. Aldrich contends, are accommodating sort of persons and adjust readily if permitted to do so in a logical, natural manner.

### Review Questions

- 1 Enumerate the advantages of breast feeding, those of formula feeding.
- 2 Why is sugar in some form added to milk in formula feeding?
- 3 What advantages does evaporated milk have in contrast to fresh milk in formula making?
- 4 What supplementations does any milk formula require? At what age are these supplements added?
- 5 At what age are the first solid foods given? Why are those particular solid foods added?
- 6 In introducing solid foods what precaution should be taken?
- 7 At what age should a baby receive a full quart of milk daily?
- 8 What may be said in regard to a rigid schedule of feeding vs a more lenient one of eating in response to hunger?
- 9 What factors should govern additions to the infant diet?
- 10 How does the metabolic rate of the infant compare with the adult?
- 11 How does the protein requirement compare? Why?

### Suggested Projects

- 1 Interview a mother of a young baby. Obtain the formula that she has been feeding the baby. How does the child react to the formula, what foods have been added and when were they added?
- 2 Interview the mothers of several infants from 6 months to 1 year. Find out when foods were added to the diet of the baby. How did each child react to the addition of the new food? What had been the child's physical progress in respect to his rate of growth?
- 3 Do you know any infants who were fed a formula composed of milks other than evaporated milk? Which product was used? Compare the formula with the information in Table 54 for calculating the usual formula.

## CHAPTER 20

### FOOD FOR CHILDREN

Nutrition is an important factor in the growth and development of children. During the preschool period the child develops muscularly and grows in height. The establishment of good food habits may begin to take place at this time. The school child continues to grow steadily. His food habits should be carefully supervised as he may eat one meal a day away from home. The nutritional demands of adolescence are exceedingly high, however, surveys indicate that the intake is likely to be deficient in many nutrients. Several methods may be used in evaluating growth which is one of the major indications of good nutrition.

A discussion of foods for children seems to fall naturally into three groups: the preschool child, or the child from 1 to 6, the school child, or the child from 6 to approximately 12, the adolescent, or the years from 12 to 20. However, it must be recognized that these are only convenient classifications, not finite. Many children will not fit into specific categories and there is wide overlapping from one group to another in terms of growth and development and subsequent food needs. Not only will the nutritive requirements be considered for these three periods, but the behavioral patterns of the child in relation to food will also be reviewed.

The food pattern of the infant during the first year of life is described in Chapter 19. It will be remembered that the last three months of pregnancy and the first three months after birth represent the period of most rapid growth of the life of the individual. Thus, there is the highest food requirement per unit of body weight during this time.

After this time however, the growth rate diminishes steadily to the lowest level of childhood, which is approximately 2 to 3 years of age. The child may continue at this plateau for usually about two or three years. The food needs per unit of body weight are relatively low at this time. The rate of weight gain and the relative metabolic rate are also at a low level.

In early years the protein intake should be at a level of 3 to 4 gm per kilogram of body weight or should supply roughly 10 to 15% of the total calories. This protein should be of high biological value. Milk is the protein of first choice. The child's diet should continue to contain the liberal amounts of milk which had been included in his diet during infancy (From 1½ pints to 1 quart per day see Normal Diet). If this proves to be too great in bulk, the use of powdered milk added to the smaller amount of fluid milk or the use of powdered milk in cooking is practicable. The continued use of egg and meat will supply adequately the remainder of animal protein. This will be supplemented by cereals to make up the required amount.

Jeans in his *Essentials of Pediatrics*, summarizes the approximate protein and energy requirements of children in Table 60.

The importance of protein of high biological value is emphasized by Stearns. She pointed out that during the period from 1 to 3 slow body growth takes place. The protein needs are high as it is a time of changing body composition. The musculature grows far more rapidly than the rest of the body if the protein intake permits such growth and development. It must be remembered that the utilization of protein by the body is dependent upon total energy intake. This is especially important during the preschool age.

Apart from providing the necessary nutrients the family must establish good eating habits and healthy attitudes toward foods.

TABLE 60\*

AGE (YE.)	AVERAGE HT (IN.)	AVERAGE WT (LB.)	AV. PROTEIN (GM.)	AV. OF TOTAL CALORIES
1	30	~	30	1 000
2	34	2	30	1 100
3	37	3	35	1 250
4	40	36	37	1 375
5	43	41	41	1 500
6	46	48	48	1 600
7	48	52	52	1 750
8	50	58	58	1 900
9	50	64	64	2 050
10	54	71	71	2 200
11	56	78	78	2 400
12	58	87	87	2 600
13	60	95	95	2 800
14	63	110	100	3 000
15	65	120	100	3 300
16	67	130	100	3 500

\*From Jeans, *Essentials of Pediatrics* reproduced with the permission of J. B. Lippincott Company.



in the child during this preschool period. When the child is approximately 18 months old, he may begin to show a decrease in appetite that continues through the second and third years. This decrease in appetite corresponds to the diminished growth rate. Frequently the mother does not understand that this is likely to take place. She will coax the child to eat more than he desires or needs and a battle over food takes place at each meal. This action on her part may bring about eating problems.

The young child, from 18 months to 2 years, may begin to express definite food preferences and likes and dislikes. Some mothers have reported that children can distinguish between different brands of the same food. As the chewing mechanism becomes more developed, meat becomes a favorite food. The child may demand repetition. Sometimes, during the period of 1 to 3 years old, the traditional "one quart of milk a day" has to be modified. A pint of milk may be easily taken and the remaining pint served in cheese, or in cooking, such as custards or puddings. Milk fortified with powdered skim milk will permit higher value with lower volume.

The 3 year old or the 4 year old child may go on food jags and food strikes. If the adults can overcome their dislike for the same food served daily for several weeks, this period will come to its natural end. Again, this is a time when adult standards are thought best not to be imposed upon children. At this age, desserts and sweets may be more desired and green vegetables more acceptable. Raw vegetables are well liked. Many foods may be accepted raw and rejected if served cooked.

On the basis of extensive work with many children, Lowenberg makes many valuable suggestions about feeding the preschool child. Some of these are: always take the child's point of view, do not worry about the table manners of very young children, remember children prefer lightly seasoned foods, study the child to learn how he prefers his foods cooked, keep mealtime conversation happy and cheerful, give children a choice between two fruits or vegetables and let them serve themselves, use lots of finger foods, keep foods simple, keep helpings small and let the child ask for more, serve spoon eaten foods in small bites which are easy to pick up and introduce new foods in small amounts, one at a time.

TABLE 61

RANGE OF AVERAGE WATER REQUIREMENTS OF CHILDREN AT DIFFERENT AGES  
UNDER ORDINARY CONDITIONS

AGE	BODY WT (KG)	TOTAL WATER IN 24 HR	WATER (KG/24 HR)
3 days	3.0	210 300	80 100
10 days	3.2	400 480	125 150
3 months	5.4	750 800	140 160
6 months	7.3	950 1,130	130 155
9 months	8.6	1,075 1,240	125 145
1 year	9.5	1,140 1,300	120 135
2 years	11.8	1,350 1,475	115 125
4 years	16.2	1,600 1,800	100 110
6 years	20.0	1,800 2,000	90 100
10 years	28.7	2,000 2,440	70 85
14 years	45.0	2,250 2,700	50 60
18 years	54.0	2,100 2,700	40 50

When the child is 4½ or 5 he observes what others eat and he is likely to be influenced by group patterns. He then becomes less demanding and is willing to accept foods given to him.


The water intake in early childhood continues to be of importance. In the White House Conference Report on nutrition the amounts in Table 61 are suggested.

There is considerable difference of opinion as to the most desirable time to have the child begin to eat with the family. Some suggest that as soon as he can sit in a high chair he should have one of his meals or part of it at least at the family table. This of course, presupposes the mother's willingness to tolerate untidiness. However, Ilg suggests that eating habits are better established if the child is fed apart from the family as late as the 2 to 3 year period. She also indicates that at 3½, the child is often ready and wants to come to a few family meals. If this is the case, she thinks that breakfast is the best meal to start this pattern. Ilg believes that from 7 on the child becomes part of the family group. However most find it practical to have young children eat with the family at an early age.

Thus the period from 1 to 6 is one of change. There are times of rapid growth with a subsequent diminished rate of growth. However it is also a period of muscular development. The nutritive needs for protein, vitamins and minerals are high, yet the appetite may be diminished. The child asserts himself with respect to foods. The mother's responsibility is to realize that how


and where the child eats is as important a part of eating as what he eats. The establishment of good food patterns can take place during this period. As Ilg so aptly said, "Be ready to listen to

## The Same Menu for All




Small Servings  
for the  
Two-Year-Old

**DINNER**  
 Broiled Meat Ball  
 String Beans, Baked Potato  
 Bread and Butter, Lettuce  
 Baked Apple  
 Milk



Medium Servings  
for the  
Six-Year Old



Very  
Generous Servings  
for the  
Ten-Year-Old

Wholesome Food Simply Prepared  
Suits the Whole Family

FIG. 60—The same menu for all (Courtesy Bureau of Home Economics, United States Department of Agriculture)

the child. He often talks more sense than we realize. He needs experience in eating as in everything else, but one should consider for what eating experience he is ready."

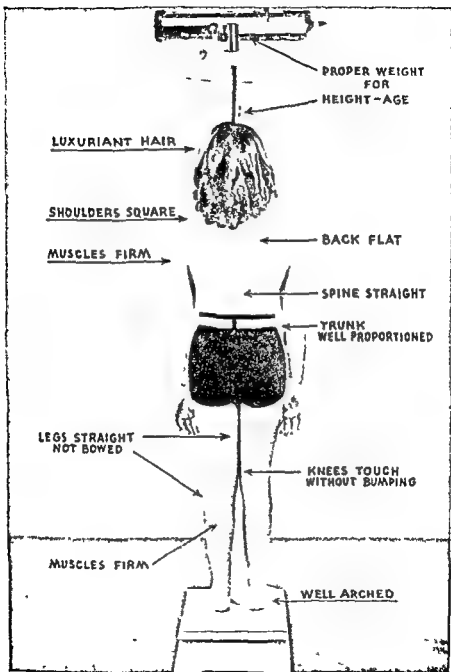


FIG. 61—The healthy child (Courtesy California Fruit Growers Exchange)

The period when the child is from 6 to 12 is characterized by continued growth. It may be relatively slow, however, height and weight will progress steadily. Some changes in height and weight should be discernible within each 3 month period. It is during this time that permanent teeth erupt and the completion of calcification occurs. (See Chapter 14.) Muscular development continues, at first in the large muscles of the arms and legs and then in the small muscles.

Usually at 6, and through the school period, the child exhibits a large appetite. He may be described as a "wonderful eater." He still has strong preferences and may refuse some foods. However, as he grows older, he becomes more and more venturesome and ready to try any food. He still prefers simple foods, though, and does not like foods combined in unknown dishes. His nutritive needs increase with his age, and are especially high in protein, calories, vitamins, and minerals. The Food and Nutrition Board considers the needs of boys and girls together until the age of 10, after which they designate different recommended allowances.

Numerous surveys have indicated that the school child does not receive recommended amounts of the necessary nutrients. According to Jeans, the nutrients most commonly found deficient are riboflavin, calcium, thiamine, and ascorbic acid. In addition he believes that protein and vitamin D deficiencies are relatively common in childhood. In a survey conducted by General Mills, Inc. on the eating habits of 59,727 school children in thirty eight states (published in 1951), it was found that 33% of the children ate diets that were classified as good, 27% as fair, and 40% as poor. They found that breakfasts were usually poor and that the diet picture was essentially the same in rural, small town, and urban communities when economic levels were not considered. Even though there is evidence to suggest that the nutrition of the school child has been improved during the past generation there is additional data which indicate that there is a great deal to be done in educating the child and his family in regard to his nutritional needs at this time.

The school age child begins to assume the responsibility for many of his own meals for the first time. He may eat lunch away from home. If there is a school lunch program in his community, he will become acquainted with new foods and he will have many

social experiences in relation to eating. He will have the opportunity to express his own food preferences by refusing to eat foods that are served. If good food habits and good attitudes about food have been established before the child comes to school he will be prepared to assume these new responsibilities.

If lunch is taken from home, or if the school child comes home for the midday meal, the menus can be planned to include part of the total day's needs. In some cases the parents receive the menus from the school lunch a week in advance. This allows the mother to plan the family meals so that there is no repetition and it also affords an opportunity to educate the school child in the proper selection of food away from home.

It must not be forgotten that the after school snack may contribute necessary nutrients. Frequently this important "small meal" is unplanned. As a result of haphazard selection little but calories may be obtained. If only sweet foods or those high in carbohydrate content are consumed the child's appetite for his main meal of the day and one that contributes a large share of important nutrients may be dulled. Thus the after school snack and the evening snack if usually eaten should be carefully planned to contribute their share of the total day's needs.

In many communities today nutrition education is being integrated into the elementary school curriculum. Learning experiences are planned according to the developmental level of the child. For example in the lower grades unfamiliar foods are prepared and Taste Parties are held. It is thought that the students might then try these new foods at home. In other schools the students help plan the menus for the school lunch. Arithmetic is taught by using real problems with foods as illustrations. Spelling is learned by making posters or writing the school lunch menus. Evaluation of such programs has shown that attitudes toward foods have improved and in many cases better diets are eaten.

The adolescent period is one of highest nutritional requirements. The onset usually occurs from ages 10 to 12 in girls and from 12 to 14 in boys. Growth is extended in all directions, it accelerates and continues to a maximum peak of gain in about two years. After this the growth rate diminishes rapidly. However, during later adolescence after the growth in height has begun to diminish there continues a period of rapid growth of

muscles. Thus, the nutritional needs are high throughout all the adolescent years. Table 3 demonstrates that the recommended allowances of the Food and Nutrition Board suggest a level of nutrients to meet these excessive demands.

It has been found that the food habits of the teen ager are the worst of all groups. A survey of the diets of thirty three Nebraska families by Leverton showed that the mothers ate the poorest diet except in families in which there were teen aged girls. Then the girls ate the poorest diets and the mothers the next poorest.

Steele reported on the food habits of a group of New York State children. Of all age groups, the adolescent girl consumed a diet that rated the poorest of all. Only 36 to 39% of the diets met the recommended dietary allowances for this age group. The diets were lowest in protein, iron, thiamine, riboflavin, niacin and vitamin C. Calcium was lacking at all ages. The adolescent boys were better, as approximately 50% of their diets met the recommended dietary allowances. Not only were the diets inadequate in essential nutrients but the menus reflected undesirable food patterns. The lunch frequently consisted of hot dog soft drink and candy bar type meal. Skipping meals was prevalent particularly among the girls and the survey revealed poor breakfast habits. It is interesting to note that the adolescent obtained about one tenth of his calories from snacks.

Research has suggested that an individual performs at his best only when he receives from one fourth to one third of the day's calories at breakfast. In the light of information disclosed in surveys regarding poor breakfast habits, nutrition education should be directed toward improving these patterns.

Mack and her co workers analyzed the food habits of 3109 teen aged boys and girls during a period of ten years from 1941 to 1951. In addition, a detailed physical examination was part of the study. Briefly stated it was found that neither the boys nor the girls met the amounts recommended by the Food and Nutrition Board of any of the nutrients included. Of course the intake varied among the nutrients however the girls were lowest in calories protein, iron thiamine and niacin while the boys were lowest in calories iron thiamine, and niacin. The diets of the boys were better than those of the girls. It was also

found that the teenagers with the poorest physical conditions were those with the poorest food habits.

The seriousness of these inadequate food patterns is recognized when research has emphasized the importance of a good nutritional preconceptional state. Pregnancy often closely follows the adolescent years. As Stearns pointed out: "A girl or young woman entering pregnancy after years of malnutrition and maintaining her customary diet adequate in calories but low in many nutritional essentials cannot possibly nourish her fetus well in the critical first 2 months of development in utero. Evidence is accumulating that excessive nausea is more common among the poorly nourished pregnant women. It is not strange that the incidence of abortion, stillbirth, and premature births tends to be high in this group. In order to assure the birth of healthy infants carried to term the mother's diet should be nutritionally adequate from early childhood so that she enters pregnancy with a full store of nutritional essentials. Thus we come full circle."

One of the great concerns of the teen-aged girl is that she retain her slim figure. Many of her poor eating habits are determined by that factor. If she can be made to realize that other aspects of her appearance are influenced by the foods she eats such as her skin, hair, posture, and her vitality, she may modify her present food habits and include items that are necessary for her general health. The adolescent boy is desirous of improved physical prowess and stamina and improved physical appearance. Through these avenues he may be persuaded to improve his choice of foods.

The adolescent needs to be able to make wise food selections. Many do not live at home as they may go away to school when they are 17 or 18. Many social events center around eating such as parties, after-school gatherings at drugstores or homes, and dating. These occasions offer opportunities to increase the protein, calcium, and riboflavin content of the diet as well as the calories by selecting a food that is as socially acceptable as another.

Table 62 indicates how the foods in the Basic Seven may be adapted to meet the needs of each age group. The caloric needs, of course, will vary with each individual child. The slogan the busy mother should be "one menu for all." It is a



## NORMAL NUTRITION

ADAPTING THE FOODS FROM THE BASIC SET			
HOW MUCH OF	LEAFY GREEN AND YELLOW VEGETABLES	CITRUS FRUITS, OTHER HIGH VITAMIN C FOODS	POTATOES, OTHER ROOTS, TABLES AND FRUITS
Children 1-3	Consult your doctor	Consult your doctor	Consult your doctor
Children 3-6	$\frac{1}{2}$ cup	$\frac{1}{2}$ cup	
Children 7-11	$\frac{1}{2}$ cup	$\frac{1}{2}$ cup	
Children 12-15	$\frac{3}{4}$ cup	$\frac{1}{2}$ cup	1 medium cooked potato and 1 serving each of other vegetables and fruits
Good sources	Asparagus, broccoli, Brussels sprouts, spinach, green beans, peas, salad greens, carrots, yellow squash, pumpkins, sweet potato	Oranges, grapefruit, tomatoes or their juices, lemons, limes, tangerines, if eaten raw, cabbage, salad greens, green peppers	Potatoes or spaghetti, macaroni, rice, dried beans, Other vegetables, raw cabbage, celery, cucumber, beets, onion, cauliflower, noncitrus fruits

\*Adapted from Table 1 Your Child Needs at Least These Amounts of the Basic Foods Daily in You Can Lengthen Your Child's Life by Dr. Herbert Polak  
Woman's Home Companion December 1953 Reprinted by permission of the author

of increasing quantity of food intake rather than changes in type of food which should be continued throughout childhood, with the exception of fried foods, tea, coffee, and rich desserts, which after all should be used in only limited amounts in any dietary. One of the criteria for good nutrition in children is their growth and development. There are other criteria that affect growth and development. Most of these are beyond the scope of the present book, but some may be mentioned here. Although some influences are not clearly understood, it is generally believed that disease, heredity, action of hormones, rest, fatigue, exercise, and perhaps seasons of the year are factors which affect growth and development.

**Growth and development** are not synonymous terms. Shelton and Skeels differentiate between the two with the following definition:

## MEET THE NEEDS OF CHILDREN OF VARIOUS AGES

MILK, CHEESE, ICE CREAM	MEAT, POULTRY, FISH, EGGS, DRIED PEAS, BEANS	BREAD, FLOUR, CEREALS	BUTTER, FORTIFIED MARGARINE
Consult your doctor	Consult your doctor	Consult your doctor	Consult your doctor
1 cup fluid whole milk or the equivalent	2 oz meat, fish, or poultry, 1 med egg	3 slices whole grain or enriched bread or the equivalent	4 level teaspoons
1 cup fluid whole milk or the equivalent	4 oz meat, fish, or poultry, 1 med egg, 2 servings a week dried peas or beans	6 slices whole grain or enriched bread or the equivalent	8 level teaspoons
1 cup fluid whole milk or the equivalent	4 oz meat, fish, or poultry, 2 med eggs, 2 servings a week dried peas or beans	8 slices whole grain or enriched bread or the equivalent	10 level teaspoons
sterilized or fresh unsweetened evaporated or powdered milk, goat's milk, skim milk, also cheese, cream or cottage cheese, ice cream	Beef, veal, lamb, pork, canned salmon or tuna, sardines, fish and shellfish poultry wild game, liver, kidneys	Whole wheat or whole rye flour, whole cornmeal, whole wheat or dark rye bread, brown or converted rice, whole grain cereals, noodles, spaghetti, macaroni	Butter and vitamin enriched margarine, cream, yellow cheese

nutrition "Growth is accomplished essentially by cellular multiplication, with increase in number and/or size of tissue units. Development on the other hand is that process which leads to differentiation into specialized functional tissues and which normally occurs concurrently with growth. Accurate definition of these terms is not merely a matter of semantics. A thorough understanding of these two processes is an important aid in the differential diagnosis of the child who is well grown but poorly developed from one that is poorly grown but well developed. Maturation may be considered the end result of normal growth and development."

Since nutrition is one of the major factors that influence growth and development, body measurements are usually included as a method of evaluating nutrition studies and surveys. Such measurements are usually kept as part of a child's health record. Various systems of measurement have been developed

whereby a child's record may be interpreted in relation to a given standard. In some cases, the standard is an average, and in others, the child serves as his own standard. The systems in general use will be described briefly. For complete descriptions and illustrations, original references are listed in the Appendix.



Fig. 62.—The process of good nutrition is a continuous one; the nutrition of a child at any period in life is dependent on that of all preceding ones. The difference in body build shown by these girls is not related to age or to nutrition. All three are 8 years old and all are well nourished. Photograph by Bureau of Human Nutrition and Home Economics (BHNHE) of the United States Department of Agriculture (USDA).

In the past tables of average heights and weights at given ages were widely used. This was based on the assumption that a child who differed very much from the so called normal stand-

and was not growing successfully (See Tables 132 133 134 and 135 in the Appendix ) It was recognized that there were natural differences in body build so that a child who might be judged undernourished from the average height weight tables might be in good health Fig 62 demonstrates a difference in body build of healthy children of the same age Some tables have been developed again expressing an average which include classifications of body build in descriptive terms such as "short stocky type" and "tall slender type" The difficulty in using these lies in deciding to which type a child belongs It is frequently the teacher who will note the height weight measurements and she has not been trained to judge the body build of her pupils

Recording the height and weight of children can serve as an indication of progress in growth if these measurements are related to previous heights and weights of the same child It is in this context as a measurement against his own record instead of a table of average heights and weights that these values are used today

Pryor has developed Width Weight tables to be used in evaluating the growth of the individuals These are based on the belief that tables of height weight age and sex do not properly consider the nature of the bony framework and the body structure of the individual These tables may be used to predict body weight in terms of width of hips and width of chest as well as height for each age and sex Pryor states that width length indices calculated every six months over a seven year period on one hundred adolescent girls and one hundred adolescent boys were found *very reliable in predicting body build during the period of most rapid growth* These width weight tables may be regarded as predicting body weight in terms of width of hips and width of chest as well as height for each age and sex Again the child may be followed in his own path of development

Another method of evaluating growth and development is the Wetzel Grid The grid is a chart worked out by Wetzel of Cleveland which may be used to follow the growth pattern of the child The grid contains nine patterns of growth each schedule expressed as a channel These channels represent nine body types and patterns of growth found in each body type that

Wetzel found in his analysis of data from his observations upon thousands of children. The child's position on the Wetzel Grid is plotted from data normally obtained at a physical examination, height, weight, and age. His channel depicts his body build and predicts his normal growth. Thus, when a child "wanders" out of his normal channel, it may serve as an indication that he is not growing as expected and further examination is indicated. The grid also recognizes that each child is different from other children, it is a continuous record that compares each child with himself. There are other ways in which the grid may be used, however, the information may be obtained from the references in the Appendix.

Two other charts which are used for evaluating the growth and development of the child are from data gathered in Iowa and from data gathered in Massachusetts. Meredith compiled the data for the former and Stuart and his associates the latter. The "Iowa charts" are designed for situations where it is not practicable to adopt a program calling for more measurements than height and weight. From these data, which are plotted on the child's chart, the following information may be obtained: a ready description of the child's over all body size at each of the ages that measurements were taken, the relation of a child's height and weight to others, and the record furnishes leads on possible deviations as a child's growth is plotted year after year. Other information may be obtained from continued use of these records.

The "Boston" charts provide a standard of reference for body weight and height (and from years 2 to 6 recumbent length) of children. By plotting these measurements upon the chart, the percentile position of the child is obtained. The number of the percentile refers to the position which either measurement of the given value would hold in any typical series of 100 children. If a child were at the 90th percentile, 89 children might be smaller and 10 larger than the measured child. The 50th percentile represents the median in the customary range. Apart from establishing the child's position in relation to others, the graph also allows for ready recognition and description of individual differences as well as the regularity of progress. Thus comparisons of percentile positions held at repeated periodic ex-

aminations indicate either adherence or deviation from previous percentile positions. Normally, it is expected that a child would remain on or near one percentile position. Again, in order to appreciate the ways in which this chart may be used effectively, the original reference must be consulted.

Thus, nutrition is important for growth throughout all periods of childhood. Recent research has indicated that how and where a child eats is an important part of the total nutritional pattern. Although progress has been made in improving the nutritional intake of children, surveys indicate that there are many children with poor food habits. Today, it is recognized that children of the same age differ greatly in size and in rate of growth and speed of maturation. The trend in present methods of evaluating growth includes these newer concepts.

### Review Questions

- 1 How does the diet of a 2 year old child compare with that of an infant of 1 year?
- 2 Should the diet of young children differ from that of the adults in a family?
- 3 What responsibilities have parents and other adults in a family in forming correct eating habits in children?
- 4 How do the food requirements of children compare with those of adults in protein content? Other nutrients?
- 5 Why are proteins of high biological value necessary in a child's diet for good nutrition?
- 6 What items should be omitted from children's diets?
- 7 Is water important?
- 8 What are the various methods of evaluating growth? What are the characteristics of each?

### Suggested Projects

- 1 Plan a diet for a 4 year old child. Compare your menus with the recommended allowances. What plans have you made to provide foods that a child of this age would like?
- 2 Plan a menu for a family showing how the same foods may be adapted for children of preschool age, 3 years old, and a teenager.
- 3 Plan a menu for a 9 year old, include an after school snack and a lunch box from home in the diet.
- 4 Plan lunches to take from home for a 17 year old boy. What variety in the lunches have you planned and what variations in texture, color, etc., have you included?

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- 5 Plan menus for a 16 year old girl which meet her nutritive needs yet provide foods she will not consider "fattening" Be sure to plan for after school snacks
- 6 Plan menus for an adolescent boy whose family is on a moderate income Be sure to meet his nutritive needs, and include after school and evening snacks Avoid foods that are concentrated in carbohydrate if possible
- 7 Interview the mother of a preschool child Find out his menu for one day Evaluate it in the light of the information set forth in this chapter Do the same for a school child, for an adolescent

## CHAPTER 21

### NUTRITIONAL NEEDS OF THE ADULT

The nutrition of the adult is being studied extensively. With the life expectancy in the United States increasing a growing percentage of our population is over 65. It is necessary that the contribution adequate nutrition makes to optimum health in the geriatric individual be recognized. The nutritional needs of the young adult and of the individual in middle years should not be overlooked. Recommended allowances provide a guide in planning menus for the adult.

In the 1953 revision of the Recommended Daily Dietary Allowances of the National Research Council the nutritive needs of adults were classified into three groups (see Table 3). This is the first time in the Recommended Allowances that such division has been made. It emphasizes the fact that the nutrition of the adult during the period between the cessation of growth and the beginning of the geriatric era is of extreme importance. This time is important to the adult for several reasons: muscular and skeletal development may still be taking place in the young adult; good nutrition is necessary to maintain optimum health during the productive years or the so-called "prime of life" years; and it is believed that good nutritional habits at this time will affect the health in later years. The three ages indicated in the allowances are 25, 45, and 65. These may be thought of as the young adult, the middle years, and the geriatric adult, respectively. Too frequently the nutritive needs of the 25-year-old and the 45-year-old have been neglected.

It has been pointed out that much can be done if we emphasize to young persons and those in the middle years that healthy aging is rarely fortuitous; that the earlier in life a start is made in relieving and maintaining optimum health, the more productive the effort will be.\*

Today interest is directed toward the nutritional needs of the older person. Little evidence is available concerning the food habits of the first two age groups, the young adult and the so

\*From *Man and His Years*, Federal Security Administration, Health Publications Institute, Inc., Raleigh, N. C., 1951.



called "middle aged" individual. Present information suggests however, that these people are not as well fed as they might be.

Swanson reported on a survey of the dietary practices of a group of 1,072 women representing a probability sample for the state of Iowa of individuals ranging in age from 30 to 95 years. One of the significant points disclosed was that approximately 86% of the women reported diets providing less than 2,400 calories, which is the recommended allowance (1948) of the moderately active woman. Swanson further pointed out that it has been shown that "within comparable dietary patterns, the protein content of the diet follows its caloric value. In turn, adequate ingestion of protein seems to insure adequate intakes of thiamine, riboflavin, niacin, and iron." The diets of the women from this survey, and others which have shown similar results may be inadequate in many nutrients and probably are leaving nutritional scars that may be reflected in health in later life.

Wilder, in an address at the Food and Nutrition Institute in December, 1952, stated that, while frank vitamin and mineral deficiencies are rare in the United States today, data from surveys and experiments in animals and in man suggest that a larger, though indeterminable, number of our adult population still suffers from so called "subclinical" or borderline deficiencies.

Another nutritional problem which is prevalent among the adult population is that of obesity. This will be discussed in detail in Chapter 22. However, obesity merits consideration at these ages, during the middle years, as its prevention at this time is believed to be an important contribution to health as a senior citizen.

Thus even though there is much to be learned about the years in between adolescence and old age it is obvious from the limited information that nutritional needs of the adult must not be overlooked.

A quotation from the Borden Review of Nutrition Research titled "Nutrition in Geriatrics" indicates why geriatrics has become an increasingly important phase of medicine. The discussion begins with a quotation from *Geriatric Medicine* by Stieglitz.\*

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\*W. B. Saunders Co. 1943

Aging is a part of living. All living matter ages and as it ages changes. Aging involves every one of the innumerable aspects of life. It begins with conception and ends only with death. Thus growth, development and maturation are just as much consequences of the occult process of aging as are the atrophies and degenerations of senility. Evolution and involution are both affected by aging. Pediatrics and geriatrics are closer than many realize. Gerontology is the science of aging in the broadest sense. The aged and aging are not the same; the aged are people, aging is a process. Whereas pediatrics is concerned with the early stages of the life span, geriatrics is that branch of medical science concerned with the physiologic and pathologic problems of older individuals. Geriatrics is thus but a part, a sub-division of the broader field of gerontology.

The quotation continues:

Geriatrics is a relatively recent branch of medical science. The greatly increased expectancy of life and the large predominance of elderly people in our present population have stimulated an interest in the problems of the aged which has hitherto been almost completely lacking. At the time of the Roman Empire life expectancy at birth was approximately 23 years. During the next 19 centuries the average rose very slowly, reaching an expectancy of 40 years by 1850 and 47 years by 1900. Following the turn of the century the rise has been dramatic, life expectancy increasing to about 63 years by 1940. The increase in the brief period from 1900 to 1940 thus almost equaled that for the preceding nineteen centuries. In 1900 17 per cent of the population of the United States was 45 years or older; by 1940 the number of persons over 45 rose to 26.5 per cent. The number of persons now over 65 in this country (approximately nine million) has increased at a rate almost five times the increase in general population rate.

The Federal Security Agency\* reports that in early 1952 there were 13 million men and women 65 years of age and over. Further, this number is increasing currently at the rate of about 400,000 a year. The increase in the country's population of 65 and over during the period of 1940 to 1950 is amazing. This group went up 36% with the increase in California and Nevada.

\*Fact Book on Aging, Federal Security Agency, 1952.

being 60% or more and in Arizona and Florida, 80% or more. This means that one in every twelve persons in the country is 65 years and over.

As Steglitz points out, the present situation is without precedent. In earlier centuries, wars, famine, and pestilence have caused severe shifts in population structure but always in the direction of relative increase of youth. Improvements of modern civilization and advances in medical science, however, have tended to extend the life of the less hardy, so that along with the increase in longevity is the problem of maintaining the health and usefulness of the new millions of the aged.

In the first quarter century of life the growth stimulus is great and structural changes are many. In the second and third quarters growth and weight are essentially stationary. The extent to which health and vigor are retained in the third quarter is dependent, to some extent at least, upon the diet that has preceded it. If the diet has been adequate until this time, and disease has not taken its toll, the adult reaches the half-century mark with a feeling of being still young, in fact, in the prime of life. From then on, however, he will be more content to watch the game than to play actively. His activities are gradually and unconsciously curtailed, his movements are slower and more deliberate, and he seeks a life of ease and comfort. Appetite is probably still keen and food is thoroughly enjoyed, but there is need for a decrease of intake to compensate for the change in activity. And as age increases, there is a gradual checking of life's fire as glandular activity slowly decreases. This is added reason for decreased food intake. On the basis of weight in fact the caloric requirement is approximately one half that of a 2-year-old child. According to the older ideas of body protein being static it was assumed that the protein requirement was definitely less since growth was no longer a factor. Today, however, the theory of a constant breakdown and resynthesis of body protein is generally accepted, thus the protein level should remain around 1 gm per kilogram—certainly not less than 0.75 gm per kilogram.

The Recommended Dietary Allowances of calories for the adult have been calculated on the basis of a reduction of approximately 5% for each decade after age 25. For ages through 24

an upward correction of 0.5% per year may be made. This is for the reference man or woman of 65 and 151 kilograms (143 and 121 pounds). Adjustments need to be made when the individual differs in body build from the reference man or woman. Formulas for such adjustment may be found in the NRC publication No. 702 *Recommended Dietary Allowances—Revised, 1953*.

It is important to recognize that the decrease in caloric need will vary with individuals. However, there are two primary factors which influence the caloric requirement. It is known that there is a decrease in basal metabolism with increasing years. Keys has suggested that there is a reduction in the basal metabolism of 5% for each decade beyond 50 years. Others have indicated that the decrease corresponds roughly to a 10% reduction between 60 and 70 years, a 20% between 70 and 80, and a 30% fall over 80. A second factor related to the decrease in calories is lessened physical activity. As an individual grows older, he tends to decrease his participation in sports, to work less vigorously, and to undertake fewer and fewer outside activities that require significant amounts of energy. As indicated above, the extent to which calories are lowered will vary with the individual and be governed by his body build, his basal metabolic rate, and his physical activity.

It has been suggested by many that the reduction in calories from the normal diet be in fats and carbohydrates. The role of dietary fat in the deposition of cholesterol is still open to question (see Chapter 39) and fat is known to retard digestion (see Chapter 6). Also, many fats cause gastrointestinal discomfort. Carbohydrate foods frequently provide only calories. It is wiser for the individual to choose those foods that contain minerals and vitamins as well as carbohydrate.

Animal studies indicate that high quality protein is important in maintaining health in the older person. Negative nitrogen balances have been found in studies with the geriatric individual. Diet surveys have shown that these people frequently have intakes that are low in protein. They often dislike milk, have difficulty eating meats because of poor teeth, and will resort to bland foods of high carbohydrate value but which contain little protein. It is generally accepted that reduced gastric hydrochloric acid is to be expected in the older persons. Walker raises

the question whether the protein deficiencies seen are due solely to low intake or to a combination of low intake plus incomplete digestion and assimilation

The protein needs of the adult, whether 25, 45, or 65 and over, are believed to be based on the formula of 1 gm of protein per kilogram of body weight. In some cases it has been necessary to give 10 to 20 gm per kilogram to obtain a positive nitrogen balance. However, Kountz and his fellow workers found that their willing and cooperative subjects could not tolerate more than 10 to 15 gm of protein per kilogram over a prolonged period.

Vitamins and minerals are frequently inadequate in the diets of older persons. Studies of groups of subjects have shown multiple vitamin deficiencies, manifestations of vitamin A and niacin deficiency. In one study, patients who had lesions and other signs characteristic of vitamin A deficiency were observed during a prolonged period during which they had access to a diet providing 10,000 I U of vitamin A daily. However, a significant reduction of these conditions occurred after four to ten months of treatment with 30,000 I U of vitamin A preparation. It was suggested that perhaps the development of these conditions, even though the diet was so adequate in vitamin A, was associated with the low gastric acidity and poor fat absorption so frequently seen in older adults.

The thiamine and niacin level in the recommended allowance for the adult decreases with the decrease in calories. The present ratio is 0.5 mg of thiamine per 1,000 calories for energy needs of less than 3,000 calories. When the intake is below 2,000 calories the thiamine allowance is not less than 1 mg daily. The recommended allowances for niacin are ten times the thiamine allowances, and, therefore, decrease correspondingly.

Calcium and iron are of great importance in the nutrition of the geriatric individual. Not only do many older people limit their intake of milk, the best source of calcium, but it also has been suggested that gastric anacidity results in poor absorption of calcium and phosphorus.

Stieglitz and many others have emphasized the importance of water in the diets of older persons. Water functions as a carrier of nutrients and waste products and, if the individual drinks an

able juice amount of fluid it may also help in the control of constipation a condition which is frequently found in older adults

In many cases it is wise to limit the indigestible fiber to soft cooked foods rather than to include raw or cooked fibrous foods such as celery raw carrots and sweet corn. Some authorities recommend that no condiments or spices be included in the diet that is those that are so strong that they burn the tongue. Some people have found it advantageous to limit their consumption of coffee and tea.

The salivary glands may be sluggish the gastric juice have a decreased HCl and the other digestive juices may be decreased in amount hence seemingly harmless foods may sometimes produce indigestion. Frequently there are physical changes in the gastrointestinal tract—lack of teeth improperly fitting dentures decreased motility atrophy etc. Absorptive ability is usually decreased. Kidney function may be impaired. Diarrhea and constipation are common complaints. Anemia is a common finding. These are factors which influence dietary planning.

To change the eating habits of those of advanced years presents a challenge. Ideally it is hoped that the young adult of today and those of the so called middle years will come to the geriatric period with food habits well directed toward good nutrition. However the older person today must learn the value of good nutrition and to realize that food is as important in old age as at any other time of life. The idea that for elderly people food is of little concern is no longer acceptable. It must be remembered that as one grows older and his outside activity decreases eating may assume a very important role in the life pattern. Even as the geriatric individual may seem indifferent to food his very lack of concern expresses an attitude which needs to be recognized and redirected.

Donahue emphasized the importance of paying attention to environmental factors that have psychological influence in feeding older people. Examples of practices which take these factors into account were enumerated by Donahue: (a) serving attractively arranged trays (if the individual is bedridden) (b) giving special decor to the institutionalized table (c) serving extra quality out of season or specially prepared foods (d) changing food flavors or food types (which is especially important in institutional settings where variety of cooking style is at

best limited), (c) using food colors in attractive combinations, (f) eliminating foods which are embarrassing for the individual "sans dents" to masticate in the presence of others, (g) avoiding foods against which the individual may have developed a phobia, and (h) giving special attention in the form of an occasional favorite dish prepared from a cherished recipe." The effects of the environment and of the various meanings that food may hold for individuals (see Chapter 1) must not be overlooked in this age group.

Dr C Ward Compton contends that man has seven ages: chronological (age in years), anatomical (stage of growth and change in cells, tissue, and organs), physiological (how effectively and normally the organs function), psychological (mental alertness and attitude), and, last, the pathological age which refers to the changes brought about by disease.

One should be able, to at least some extent, to control his aging through medical care, proper diet, correct health habits, and a philosophical and tolerant outlook on life.

In summary, then, the diet of the young adult and the adult in his middle years should receive attention, as well as the food of the older person. The logical diet of the geriatric individual is one of adequate protein, decreased fat, and enough carbohydrate to yield sufficient calories to meet the specific need. The meals should be simple, relatively low in indigestible fiber, and should be devoid of highly seasoned and gas-forming foods. Six small meals are preferable to three hearty ones. In addition, adequate rest, relaxation, occupation, and "fun" must be considered as part of his health program.

As Piersol and Bortz suggest, "Add life to years rather than years to life." To combat the ills which normally accompany advancing age, good nutrition is important. The age of tea and toast is past.

### Review Questions

1. At what time does the aging process begin?
2. How well fed is the adult population in the United States today?
3. What are some of the problems that are prevalent among the adult population today?
4. How does the diet differ in old age from other periods? What are some of the physiological reasons for such changes?

- 5 How and why have our ideas changed in the care and treatment of elderly people?
- 6 What is the name given to the branch of medicine which deals with this group?

### Suggested Projects

- 1 Interview an individual over 65 years of age. Obtain a diet history from him. (See Table 70.) Evaluate the nutritional content of the diet. Find out the likes and dislikes of this patient, if he cannot eat certain foods, and why he may omit them from his diet. Discuss his reaction to the environment of his meal service. Do you have any suggestions to help him?
- 2 Conduct the same type of investigation for several adults such as working girl, a homemaker, a businessman.



in preference to the dark fish, such as tuna, salmon, mackerel, and sardines. The latter contain large quantities of fat. If used at all, boiling water should be poured over the broken pieces until the oil is completely removed.

- 6 Eggs—three or four each week, 1 per day is preferable—in any way except fried.
- 7 Cheese—generous amounts of cottage cheese. All other kinds should be omitted from the diet. The cottage cheese may be variously flavored by the addition of chopped chives, pickles, onions, tomato or pineapple juice, green peppers, etc.
- 8 Fats in very small amounts, approximately 3 to 4 tea spoonfuls daily. These may be butter, margarine, oil or cream. Other fats, such as meat drippings, should be omitted.

Clear soup, bouillon, or beef tea, tea and coffee may be used as desired. They have no food value. Likewise "diabetic" gelatin is palatable and an excellent filler.

Oil salad dressing, candy, pies, cakes, cookies, corn, peanut butter, nuts, jellies, jams, fat meats, Lima beans, fried foods, spaghetti, macaroni, crackers, dried peas, beans, or lentils potato should be avoided, as should foods usually consumed as between meal snacks.

The way in which these foods are adapted depends upon the individual food pattern. Many factors have to be considered (see Chapter 26), such as economic resources, cultural patterns and environmental conditions under which the individual lives. The diet must satisfy (have variety value) and it must not make the dieter either unduly conspicuous or self-conscious. And, last, in most instances the diet must be such that the individual will be maintained in a state of health and strength compatible with his normal occupational activity.

There are many combinations in which these foods may be used. Some of the milk and egg may be made into custard, or the breakfast cereal may be omitted and rice or tapioca pudding prepared. Celery, watercress, chives, radish, and peppers used as garnish need not be counted.

The day's bread may be used in a sandwich with meat, cottage cheese, lettuce, cabbage, etc. if the noon meal is the lighter meal.

Four very thin slices of home cut bread will equal two slices of ready sliced bread. It seems like more bread. Made into Muffins the need for butter is obviated due to the altered flavor.

When a lower caloric intake is desired the following diet outline may be used *but only when medical supervision is available*

700 caloric level 1½ pints of skim milk 23 cups of 5% vegetable 2 ounces of meat 1 egg 3 oranges 1½ cup of cottage cheese

1000 caloric level The above diet and in addition—1 small serving of cereal ½ cup 10% vegetable 1 piece of sliced bread 1 ounce of meat or fish

One may prefer to Gradually use smaller sized portions of food. Change to the diet as outlined at once and then gradually decrease the size of the serving until the amount indicated is reached. It may be more satisfactory to do this slowly and faithfully than to make a sudden change by decreasing the diet to the point of extreme hunger.

For an individual whose caloric requirement is 2000 a reduction below 750 calories should never be undertaken and even this low level only when drastic reduction is imperative. In general it is distinctly unsafe to reduce caloric intake to a point below one half the required calories because such adjustment of food essentials is extremely difficult. To repeat *reduction should be medically supervised*

At levels of 1200 calories or less commercial vitamins must be administered to prevent deficiencies in the vitamin B group and the fat soluble vitamins.

Recently a study of Ohlson which was duplicated by Young indicated that a diet containing a higher percentage of the total calories in fat than has been practiced formerly seems to give great satisfaction to the reducer. The patients who participated in these studies said that they were not hungry between meals they felt well and they were satisfied with their diets.

Exercise in order to maintain or reestablish normal muscle tone is important not strenuous exercise but well planned exercises and exercise. It is said that the difference between a good

figure and a lumpy one is the muscular development. Fat loss must be replaced by well toned muscles for organ support. Sudden withdrawal of fat pads is dangerous.

It has been calculated that from the first to the one hundred third floor of the Empire State Building there are 2240 steps, to climb this would require 2,000 calories, which would correspond to about  $\frac{1}{2}$  pound body fat. To lay 14,731 bricks would cost 4,000 calories. Obviously, exercise alone is a foolish attempt at weight loss aside from the fact that strenuous exercise is usually accompanied by an increase in appetite. The sudden weight loss in violent exercise is due largely to water.

TABLE 64

THE NIBBLE	APPROXIMATE MILEAGE TO "WALK IT OFF"
1 caramel	0.7
1 inch cube of chocolate fudge	1.3
1 jelly bean (who can stop with one?)	0.1
1½ ounces milk chocolate (a 5 cent bar)	3.3
1 graham cracker	0.7
1 cup ginger ale or other soft drink	12.2
1 cup beer	12.2
1 ice cream cone (5 cents)	15.17
1 ice cream sundae	5.7
1 doughnut	2.8
1 salted peanut	0.1
1 date	0.305
1 cup popcorn (without butter, though you probably don't eat it that way)	1.0
1 tablespoon butter (a very modest allowance for the popcorn)	1.5
1 sliced ham sandwich	25.35
1 piece mince pie (4½ inches at circumference)	6.5
1 piece chocolate loaf cake (3 × 3 × 2.3 inches)	1.5

In *The Cornell Bulletin* on 'How to Control Your Weight' Dr. Hazel Hauck includes a table to indicate the energy value of some common snacks in terms of the miles needed to be walked in order to use up the energy which they provide (Table 64).

It is difficult to find the time to participate in enough exercise to appreciably bring about a caloric deficit of several hundred calories which can easily be accomplished through diet restriction. However, there are many opportunities whereby the dieter can expend extra calories, such as walking a few blocks instead of taking a bus or driving the same distance. Energy expendi-

ture even though it might be of short duration yet, if constant can add to the caloric deficit and thereby contribute to subsequent weight loss.

Drugs are frequently used these last several years as a means of appetite curtailment. In some instances under a physician's direction these may be justified. They may have an unwanted effect on blood elevation and *should never be self prescribed*. The use of thyroid without supervision is also dangerous.

In those individuals whose metabolic rate is lower than most the addition of a thyroid preparation to counteract the glandular condition will usually result in satisfactory increase in metabolic rate and corresponding weight reduction. The activity of the thyroid gland can readily be ascertained through determination of the basal metabolic rate (see Metabolism Chapter 8). Roughly each grain of thyroid (U.S.P.) will increase the basal metabolic rate by 10%. *Thyroid and other drugs should be taken only when adequate medical supervision is available*. Unfortunately many so called obesity cures on the market today contain such drugs and their use should be avoided. Also available are vitamin mineral pills with accompanying instructions which are planned to produce a low caloric diet—these without the firmed product would bring about weight loss if instructions were faithfully followed.

Thus the present belief is that a caloric deficit must occur in order to bring about weight loss in the obese. This may be done through a reduction in energy intake, an increase in energy expenditure or a combination of both. When a low caloric diet is planned care must be exercised to follow the usual eating habits of the overweight individual as much as possible. The patient must be convinced that weight loss is necessary and that a modification of his food pattern now and in the future will be effective in reducing and staying reduced. Without complete cooperation on the part of the patient he may not maintain his weight loss. Recently investigations have studied the effect of a group of overweight individuals trying to lose weight together under the guidance of a physician, a nutritionist, a psychiatrist or some other qualified group leader. Though these are pilot studies the evidence suggests that group discussion may be an effective method in the treatment of

obesity. However, since most, if not practically all, overweight can be prevented, today educational programs by medical centers, private physicians, schools, health departments, and life insurance companies are directed toward convincing the general public that it is to the advantage of all not to become overweight. For the most part, the public is made aware that it is possible to keep from gaining weight. If weight gain does occur it is not inevitable with advancing years. Rather, it is a symptom which should immediately direct the individual toward medical help.

### The Underweight Individual

On the opposite side of the picture from the obese individual is the malnourished or underweight person, who, due to dietary habits, activity, hyperglandular secretion, chronic illness, acute illness, or abnormality in food utilization (see Table 73), is below normal weight for his height and age. In many of these cases diet adjustment requires even greater ingenuity than for the obese person. Protein and caloric intake must be liberal and must exceed the daily needs in order that depleted stores may be restocked.

Fats in the form of cream, egg yolk, salad dressing, cream cheese, etc., are concentrated foods and excellent "padding." However, excessive amounts may have the reverse effect through the prolongation of the time of digestion and the resultant decrease in appetite (see Chapter VIII).

Milk may be padded with powdered whole milk, skim, or malted milk in such a manner as to double or triple its concentration. Many flavors are available, which prevents monotony. Such preparations as Cal C Tose, Betene, Ovaltine, Meritene, etc., serve the purpose of adding extra food value and variety. Gelatin may be dissolved in fruit juices if drunk immediately. Eggs may be concealed in a variety of foods.

Cereals, starchy vegetables and breadstuffs are concentrated carbohydrates and are excellent carriers of fats (butter, cream, peanut butter).

If weight is to be increased, the caloric intake must contain from 25 to 50% more calories than the normal requirement of the individual. As in weight reduction, a gradual increase may be much more effective than a sudden change in dietary habits.

TABLE 65

## MENUS ADAPTED FOR WEIGHT GAIN AND WEIGHT LOSS

WEIGHT GAIN		WEIGHT LOSS	
Calories		Calories	
Breakfast			
Orange juice	50	Orange juice	50
2 eggs scrambled	212	Poached egg	77
2 slices toast	110	1 slice toast	55
3 tsp butter	150	1 tsp butter	50
Coffee		Coffee, black	—
2 Tbsp heavy cream	90		
2 tsp sugar	32		
	644		232
Lunch			
Sandwich		Sandwich	
2 slices bread	110	2 slices bread	110
3 tsp mayonnaise	92	1 tsp mayonnaise	30
1 oz tuna fish	56	1 oz lean beef	88
lettuce leaf	—	lettuce leaf	—
carrot slices	21	Carrot sticks	21
Layer cake	322	Apple (medium)	76
1 glass whole milk	166	1 glass skim milk	97
	767		412
Snack			
Danish pastry	195	Coffee, black	—
Coffee			
2 Tbsp heavy cream	90		
2 tsp sugar	32		
	317		
Dinner			
Clear soup	9	Clear soup	9
3 crackers—butter	170	3 oz lean pot roast	197
6 oz lean pot roast	394	1½ cup peas	55
1½ cup mashed potatoes	120	Chef's salad	10
butter—gravy	75	vinegar tomato dressing	2
1½ cup peas—butter	100	½ grapefruit	75
Chef's salad	10	Coffee black	—
French dressing	59		
½ grapefruit	75		
Coffee			
1 Tbsp heavy cream	90		
2 tsp sugar	32		
	1134		348
Evening Snack			
1 glass whole milk	166	1 glass skim milk	87
Sandwich		2 saltines	34
2 slices bread	110	1 oz cheese	40
1 oz toasted cheese	105		
2 tsp butter	100		
	481		161
Total calories	7344		1,153

Malnutrition may be a dominant factor in many diseases and may be a matter of grave importance. The physical surroundings, attractiveness and palatability of the food, and the mental attitude of the patient usually require special consideration (see Fig. 2). Small and more frequent feedings may be desirable (see Chapter 27).

It is possible to plan two diets which, to the casual eye, would be nearly identical as to ingredients and quantity. However, twice as many calories may be included in one of them. The difference lies only in the concentration of the foods themselves. Using the outline for the normal diet, the underweight and the overweight could be served the meals suggested in Table 65. Both would be satisfied and neither would be conscious of caloric adjustment and, with that psychological factor eliminated, the diet would be more easily followed. A diet which gives a feeling of hunger or of fullness or which psychologically is not satisfying will not be followed willingly.

Frequently small between meal "snacks" of fruit, fruit juice, milk or milk drinks is of distinct value in a weight gaining regimen. Its effect on the next meal, however, must be considered, also the practicability of obtaining the extra meals. In some cases a bedtime meal can add several hundred calories to the day's intake without affecting the appetite.

As such dietary adjustments are made, it must be remembered that activity plays a large part in determining the caloric need. Due consideration must be given to this element, and an attempt must be made to have the activities supplement the caloric change rather than counteract it.

### Review Questions

1. What are the factors that may influence a gain in weight?
2. Why is it undesirable to be above ideal weight?
3. What is the difference between obesity and overweight?
4. How may obesity and overweight be determined?
5. What is the difference between tables of average weights and tables of desirable weights?
6. How may the loss of weight per week be predicted?
7. What are the principles of a low caloric diet?
8. What foods may be eaten by the underweight individual which are forbidden for the obese?
9. What are the principles in planning a diet for the underweight individual?

### Suggested Projects

- 1 Examine your own menus. Calculate the total caloric content. Is it above or below that recommended for your age group in Table 3?
- 2 Determine your caloric expenditure, using the food nomogram in Chapter 8. Is your expenditure approximately the same as your energy intake? If not, is the change in energy balance reflected in your weight?
- 3 Using your own diet as a pattern, plan a 1200 caloric diet for yourself. Is it a diet that you would adhere to? What foods would you have to do without that you particularly like? What difficulties would you encounter in following the diet?
- 4 Plan a diet for a homemaker who is the only one in the family that needs to lose weight. How can her meals be adjusted from those of the rest of the family? Will she have any difficulty in following her diet?
- 5 Plan a weight loss regimen for a teen age girl. Be sure to include foods for after school and all the social occasions in which she will want to participate. How many calories do you need to include in order to meet the nutritive needs of a teen ager?
- 6 Plan a weight loss diet for a man who eats his lunch in a restaurant. Most of these luncheons are business appointments and he eats accordingly. How may these meals fit into his reducing program? What will be his problems in following the diet?
- 7 Plan a weight gaining program for a teen age boy. Be sure to plan for foods that he will want to include in his diet. What is the per cent above his caloric expenditure that you have planned to include? What difficulties do you think he will encounter in following the diet? What will be the relative expense of this diet regimen?



## CHAPTER 23

### FOOD CUSTOM AND CULTURE PATTERNS

The American people come from all parts of the world and this variation in origin is reflected in our food patterns. In America, there are many who are foreign born who brought food customs from their native lands with them to this country. There are others born here who still adhere to the foods of their parents. Some may retain certain favorite dishes while accepting newer ones which they have learned here. Still others may be the children of marriages between two different cultures and their food patterns indicate a blending of many patterns. Whatever the source for the food pattern, it is necessary to have some understanding of its origin and to appreciate the nutritive value. Food patterns cannot be modified, either for improved nutrition or for therapeutic diets, unless such insight is incorporated in teaching.

As indicated in Chapter 1, food preferences are obtained primarily from the home. There is wide variation in the foods used within any one country and, frequently, among families. So, it is impossible to attribute certain foods as always occurring in the menus of a country or of a family from that country.

There are three primary factors which may affect the native food patterns, geographic, economic, and religious. Of course, there are many other influences which might be enumerated, but few have such far reaching effect as those designated above.

Obviously the location of a country will affect its food pattern. If there are large coastal areas or many inland lakes, fish may be a staple of the diet. If the climate is such that there are many varieties and plentiful amounts of fruits, these will be found in the daily diet. Similarly, if the country is mountainous, the people of that region usually eat food that is raised there. The degree of development of transportation within a country itself affects the food pattern. For example, if there is very little communication and transportation within a country, there is likely to be small exchange of commodities from the coastal areas to the inland regions. Here in America many food patterns are

typical of a specific section, such as New England, the West Coast, the Midwest, and so on. This is a reflection of the days when there was little commerce from region to region.

A second major factor that influences the food pattern may be designated as *economic*. The family income is reflected in the kinds of foods that are on the table. The farm family usually produces much, if not most, of its food, while those who reside in urban areas must purchase food that is within a budget. In many farm families, in America as well as in other countries, it is the custom for the women to work outside along with the men, hence, such patterns as second breakfasts and one dish main meals which could be cooking while all worked originated. Frequently, a pattern was established while a family or a region was in certain financial circumstances. Then, although they have become more affluent, they may still adhere to the pattern which is typical of their former financial status. However, it must be kept in mind the amount of money spent for food does not necessarily reflect its nutritive value, a menu which is very expensive may be less nutritious than an inexpensive one.

Among the strongest influences upon food patterns are the customs associated with *religion*. Many beliefs are well known. The Moslems cannot eat pork. Catholics cannot eat meat on Fridays and other religious holidays, and some sects practice vegetarianism.

The Jewish religion has many dietary laws which determine food patterns. Generally speaking the Jewish people adopt the food customs of the country in which they live and adapt these foods within the framework of the tenets of their religion.

Only the forequinters of animals that chew the cud and have cleft hoofs are permitted. All meat must be killed in a prescribed manner (see below) after which it is called kosher meat. Fish with fins and scales are allowed. There are three groups of foods: meat and poultry, milk and its products, and neutral foods such as fish, eggs, cereals, fruits, and vegetables. The neutral foods may be served with each of the first two groups but milk and its products may never be served with meat or poultry. Bread that is eaten at the meat meal contains no milk or butter and bread that is eaten with the milk meal must contain no animal fat. Frequently a neutral bread is made which may be used with either group.

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Only the forequarters of animals that chew the cud and have cleft hoofs are permitted. All meat must be killed in a prescribed manner (see below) after which it is called kosher meat. Fish with fins and scales are allowed. There are three groups of foods meat and poultry milk and its products and neutral foods such as fish eggs cereals fruits and vegetables. The neutral foods may be served with each of the first two groups but milk and its products may never be served with meat or poultry. Bread that is eaten at the meat meal contains no milk or butter and bread that is eaten with the milk meal must contain no animal fat. Frequently a neutral bread is made which may be used with either group.

## FOOD CUSTOMS AND CULTURE PATTERNS

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES, RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES, FRUITS	IV MILK, CHEESE, ICE CREAM	V MEAT, POULTRY, FISH, EGGS
<i>Italian</i>				
Broccoli Dandelions Fennel Green peppers Escarole Spinach	Tomatoes (large amounts as sauce)	Egg plants Zucchini squash Potatoes (occasionally) Fruits in season Legumes Lentils Kidney beans Chick peas Dried split peas	Milk (less used here) Milk Cheese	Beef Lamb Organ meats Highly seasoned meats (salami, sausage, etc.) Fish (occasionally) Eggs (fried)
<i>Near East: Armenia, Greece, Syria, Turkey</i>				
Broccoli Dandelions Peppers	Tomatoes	Cucumbers Egg plant Leeks Okra Onions Potatoes (seldom) Dried Apricots Raisins Figs Dates Melons (summer) Fruit compotes Dried beans Peas, lentils Nuts (occasionally)	Fermented milk Sour cream Pasteurized milk (particularly children)	Lamb Chicken Eggs Fish, fresh, salted, smoked

Foods unless otherwise designated are used in both the native country and the United States

Italics indicates foods used primarily in the native country

Black type indicates food adopted after coming to the United States

Kosher meat, meat from an animal that is killed by a special official in a manner which drains as much blood from the animal as possible, is sold only at kosher markets. It must not touch any prohibited foods. Usually meat is not considered kosher

## ED TO THE BASIC SEVEN

VI AD, FLOUR AIS, WHOLE N ENRICHED	VII FATS OILS, BUTTER	SWEETS MISCELLANEOUS	COMMENTS
<i>Italian</i>			
a white l l products as mac , spaghetti meal po n (Northern s)	Olive oil Butter Salt pork	(cheese (holiday) Chestnuts Sweets Candy Garlic (flavor ing)	<ol style="list-style-type: none"> <li>1 Dislike American cheeses, prefer native varieties and may pay excessive prices for imported Italian cheeses</li> <li>2 Green vegetables are well liked and served in large portions, variety as salads</li> <li>3 Soups are frequently made with legumes</li> <li>4 Seldom use cream, except in special desserts</li> <li>5 Desserts seldom used, fruit frequently served as dessert</li> </ol>
<i>Near East Armenia, Greece, Syria, Turkey</i>			
l, cracked at, thin and l, white r	Ripe olives (no butter) Lamb fat Seed oils Olive oils Margarine	Grapevine leaves (imported here) Many herbs and spices Honey Sugar Coffee thick sweetened	<ol style="list-style-type: none"> <li>1 In native country, fermented milk and sour cream are used in combination with many foods soups, meats, vegetables with pastries and cottage cheese</li> <li>2 Vegetables frequently fried, may be broiled or stuffed with cereal, or served as a one dish meal</li> <li>3 Diet may be low in ascorbic acid content</li> <li>4 Pattern frequently includes a hearty main dish</li> <li>5 May substitute wilted cabbage leaves for grapevine leaves</li> </ol>

(Continued on page 334)

after seventy two hours After the meat is purchased and in the home, it is further treated It is soaked in water one half hour, salted liberally, placed on a perforated board and then allowed to drain for one hour to remove as much of the remaining blood as possible If a patient who is an orthodox Jew is placed on a low sodium diet, it is necessary to consider the amount of

## NORMAL NUTRITION

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES, RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES, FRUITS	IV MILK, CHEESE, ICE CREAM	V MEAT, POULTRY, FISH, EGGS
Spinach	Cabbage Tomatoes Citrus fruit (small amounts)	<i>Czechoslovakian</i> Legumes Lentils Yellow split peas White navy beans Carrots Potatoes Beets Celeriac Kohlrabi Turnips Onions Dried fruits	Buttermilk Clabber Cottage cheese Sour cream Milk, goat's or cow's Milk (not as liberal as formerly)	Eggs Sausage Internal organs (lungs, heart, tripe, etc) Beef Pork Veal
Cabbage Broccoli Green peppers Cauliflower Celery Cucumber Green beans Kraut		<i>Polish</i> Potatoes Beets Carrots Root vegetables Mushrooms Legumes (widely)	Milk Sour cream Cheese Cottage cheese	Beef Pork Veal Eggs (fre- quently) Fish, fresh salted, pickled Geese Duck Poultry Internal organs
Cabbage (frequently) Tomatoes	Pota- toes } fre- Turnips } quently	<i>Irish</i> Buttermilk (frequently) Cheese (small amounts)	Eggs (boil- ed) Bacon (fre- quently) Mutton (oc- casionally) Beef (seldom) Fish, cod, hal- ibut Lamb (fre- quently)	

61—CONT'D

VI REFINED, FLOUR CEREALS, WHOLE GRAIN ENRICHED	VII FATS, OILS, BUTTER	SWEETS MISCELLANEOUS	COMMENTS
<i>Czechoslovakian</i>			
Rice Barley Farina Cream of Wheat Oatmeal Pumpernickel Sour rye bread Dumplings (white flour)	Butter Bacon Goose fat	Honey Candy Seeds Spices Nuts Sweetened car- bonated bev- erages	1 Milk used liberally in cooking, though not often used as a leverage and often not as freely here as in native country 2 Meals frequently consist of hearty one dish meals 3 Wide variety of vege- tables used 4 Wide variety of cereals used in many interesting combinations
<i>Polish</i>			
Oatmeal Cornflakes Dark rye bread White bread (children) Buckwheat Oats Rice	Butter (mod- erately) Lard Bacon fat Poultry fat Suet Oils Flax Hemp Sunflower Salad oils	Pastry (on spe- cial occasions) Desserts (sel- dom) Candy (liberal) Sugar (liberal) Honey Jam Dill Saffron Mace	1 Milk and sour cream used less widely in United States than in native country, often used in soup 2 Milk given to children, adults prefer cheese 3 Vegetables cooked for long time, principally in soup or boiled and served with hot milk 4 Eggs may be fried or boiled 5 Fish is usually used only on Fridays 6 One dish meals very pop- ular 7 Inexpensive cuts of meat cleverly used
<i>Irish</i>			
Oatmeal Indian meal porridge White baker's bread Rye Oaten cake Whole wheat bread	Butter (small amounts) Lard drippings (cooking)	Cake } frequently Pie } Tea with sugar (frequently) Sugar	1 Buttermilk used with potatoes and cereals 2 No cream used 3 Most vegetables are cooked in soup 4 Little fresh fruit used, some stewed fruit and sauces are used for des- sert 5 Sugar is added freely to prepared foods





61—(CONT'D)

VI BREAD FLOUR CEREALS WHOLE GRAIN ENRICHED	VII FATS OILS BUTTER	SWEETS MISCELLANEOUS	COMMENTS
<i>Czechoslovakian</i>			
Ice Barley Farina Cream of Wheat Oatmeal Pumpkin seed Sour rye bread Dumplings (white flour)	Butter Bacon Goose fat	Honey Candy Seeds Spices Nuts Sweetened car- bonated bev- erages	1 Milk used liberally in cooking, though not often used as a beverage and often not as freely here as in native country 2 Meals frequently consist of hearty one dish meals 3 Wide variety of vege- tables used 4 Wide variety of cereals used in many interesting combinations
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Oatmeal Cornflakes Dark rye bread White bread (children) Buckwheat Oats Rice	Butter (mod- erately) Lard Bacon fat Poultry fat Suet Oils Flax Hemp Sunflower Salad oils	Pastries (on spe- cial occasions) Desserts (sel- dom) Candy (liberal) Sugar (liberal) Honey Jam Dill Saffron Mace	1 Milk and sour cream used less widely in United States than in native country, often used in soup 2 Milk given to children adults prefer cheese 3 Vegetables cooked for long time principally in soup or boiled and served with hot milk 4 Eggs may be fried or boiled 5 Fish is usually used only on Fridays 6 One dish meals very pop- ular 7 Inexpensive cuts of meat cleverly used
<i>Irish</i>			
Oatmeal Indian meal porridge White baker's bread Rye Oaten cake Whole wheat bread	Butter (small amounts) Lard drippings (cooking)	Cake } frequently Pie } Tea with sugar (frequently) Sugar	1 Buttermilk used with potatoes and cereals 2 No cream used 3 Most vegetables are cooked in soup 4 Little fresh fruit used, some stewed fruit and sauces are used for des- sert 5 Sugar is added freely to prepared foods

## NORMAL NUTRITION

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES FRUITS	IV MILK CHEESE ICE CREAM	MEAT & FISH
<i>Puerto Rican</i>				
Green peppers	Tomatoes Tomato purée	Plantain Chayote Cassava Malangas Yams Yautis Legumes Black beans Lima beans Navy beans Pinto beans Red beans Chick peas Okra Onions Bananas	Cheese (small amount) Milk (occasional)	Eggs (small amount) Fish Fish dried salted
<i>Mexican</i>				
	Tomatoes (daily) Citrus fruits	Dried beans Chili peppers Bananas Onions Cabbage Turnips	Milk (small amounts)	Beef Chicken } fr Pork } qu Lamb Fish
<i>Portuguese</i>				
Kale	Cabbage	Green beans Fruit Fruit (seldom)	Milk (seldom) Cheese (on bread)	Fish (fre- quently) Sausage (fre- quently in so- Beef Pork } sel sausage } Veal Eggs (occasional)
<i>French Canadian</i>				
	Cabbage (fre- quently) Apples (fre- quently) Green toma- toes pickled (frequently)	Turnips } prin Beets } cipal Peas } Salt meats (winter)	Milk (small amounts) Cheese (sel- dom)	Salt fish (fre- quently) Pork (fre- quently) Beef (seldom)
<i>Chinese</i>				
bamboo shoots		Soybeans (fre- quently) Legumes Vegetables (native)	Milk (small amounts for children and infants) Cheese (sel- dom)	Eggs Fish Meat Poultry } small amount

6 (CONT.)

VI FRESH FLOUR (CEPAIS WHOOP CEPAIS ENRICHED)	VII FATS OILS, BUTTER	SWEETS MISCELLANEOUS	COMMENTS
<i>Iucro I can</i>			
Ice	Lard Salt pork Ham fat	Ancho (color ing matter) Garlic Coffee (every one) Molasses Olive oil	1 Stew is a common dish 2 Usually buy foods from meal to meal 3 If cannot find native foods in local markets normally may not experi- ment with substitutions or new foods
<i>Mexican</i>			
Corn meal (for tilla) Wheat (milled) Noodles (occasional)	Butter (seldom)	Sweet rolls Sugar Coffee	1 One chief meal eaten usually at noon 2 Meat usually served as a stew
<i>Portuguese</i>			
Corn products Bread (white flour corn meal)	Lard	Sweets (limited)	1 Cereals other than corn omitted in native land 2 Vegetables served in soups after long cooking 3 Fresh fruit seldom used here 4 Meat usually used as a flavor
<i>French Canadian</i>			
Oatmeal White bread (made with water) Corn bread	Lard Butter (occasional) Cream (fre- quently)	Pastries Cake } fre- quently	1 Vegetables are often cooked too long a time in soups
<i>Chinese</i>			
Rice (South China) Wheat (North China) Rice Wheat	Sesame oil Lard		1 Wide variety of native vegetables included in daily menus 2 Soybean curd widely used supplies calcium to the diet

sodium obtained from the koshered meat. Meat may have to be omitted from the menu, however, the alternative dairy foods is often fairly high in sodium. (See Chapter 39.)

Foods prohibited are pork and its products, bacon, ham, and lard, blood in any form, so an egg with a clot would be discarded. Suet of oxen, sheep, and goats is not used, nor is the hind quarters of any animal. All shell fish are not allowed. Milk or milk products may not be served from three to six hours after a meal at which meat was served. Cooking is prohibited on the Jewish Sabbath. Special foods are associated with religious holidays, the observance of Passover lasting eight days. On some religious days, no food is eaten. In order to maintain full separation of meat foods from dairy foods, two complete sets of dishes are used in addition to a special set for Passover. However, glass dishes may be used for both meat meals and dairy meals.

Table 66 is included to suggest some of the food custom and culture patterns which may be found in the diet of many Americans. No one individual will adhere to the rigid pattern represented. As indicated earlier, there is usually a blending of new patterns with the old when coming to the United States. Table 66 in many cases, indicates customs that were practiced in the native country, foods obtained in both the native and adopted land, and foods which have been included after coming to the United States.

It must be kept in mind that frequently a newcomer will do without many necessary things in order to buy familiar yet expensive imported food. Or, if native foods are unobtainable he will do without. Sometimes changes are made, such as substituting white flour for whole wheat, which are not as nutritious as the native food pattern. Apart from including comments about the food customs, Table 66 has listed foods in the Basic Seven groups. This may facilitate an evaluation of the diet. However many other foods may be included in the patient's menu which are not shown here which may contribute to the total nutritive value.

## CHAPTER 24

### A REVIEW CHAPTER ON THE ESSENTIALS OF AN ADEQUATE DIET

Many years ago Carl Voit defined food as a palatable mixture of foodstuffs which is capable of maintaining the body in an equilibrium of substance or capable of bringing it to a desired condition of substance." The ideal food he further stated is a palatable mixture of foodstuff arranged together in such proportion as to burden the organism with a minimum of labor. An analysis of that definition indicates the completeness of his understanding.

Food to be utilized most efficiently must be palatable and it must be eaten with enjoyment. It must be attractive in appearance and it must satisfy. In order to have adequacy there must be a mixture of foodstuffs in total readily utilizable from the standpoint of digestion. The amounts and properties of the foodstuffs in the mixture must be such that balance may be maintained between intake of necessary nutrients and outgo of waste products. That such equilibrium is essential is demonstrated by feeding experiments in which one or more dietary essentials are inadequate or lacking and study of the profound effects which follow restricted diets. Such experiments clearly indicate the potential dangers of our frequently lax food habits. McLester in a discussion of the normal diet expressed the idea that *man's place in future history will depend in no small degree upon the food which he eats*. McLester is by no means alone in this belief; therefore the first consideration in diet construction should be to keep the individual in a state of good nutrition or to bring him to this condition for his own sake and for the sake of posterity.

When a diet is to be taken for only a short time such as three or four days the nutritive balance is of relatively small importance but when it must extend over a long period it must be adequate if deficiency diseases or their sublethal symptoms are to be prevented. Preventive medicine will eventually begin with diet adjustment. Malnutrition whether its source be lowered caloric intake, specific shortage of any one food or imbalance between food constituents always results in decreased efficiency.

TABLE 67

FOOD AND NUTRITION BOARD, NATIONAL RESEARCH COUNCIL, RECOMMENDED DAILY DIETARY ALLOWANCES,\* REVISED 1953  
DESIGNED FOR THE MAINTENANCE OF GOOD NUTRITION OF HEALTHY PERSONS IN THE UNITED STATES  
(Allowances are Considered to Apply to Persons Normally Vigorous and Living in Temperate Climate)

AGE YR	WEIGHT KG (LB.)	HEIGHT CM (IN.)	CALORIES	PROTEIN GM	CAI CIUM GM	IRON MG	VITA MIN A IU	THIA MIN B MG	RIBO FLAVIN MG	NIA CIN MG	AS CORBIC ACID MG	VITA MIN D IU
Men	25 45 65	65 (143) 65 (143) 65 (143)	170 (67) 170 (67) 170 (67)	3,200† 2,900 2,600	65 63 63	0.8 0.8 0.8	12 12 12	5,000 5,000 5,000	1.6 1.6 1.6	16 15 13	75 75 75	
Women	25 45 65	55 (121) 55 (121) 55 (121)	157 (62) 157 (62) 157 (62)	2,300† 2,100 1,800	55 53 55	0.8 0.8 0.8	12 12 12	5,000 5,000 5,000	1.2 1.1 1.1	12 11 10	70 70 70	
Pregnant (3rd trimester)				Add 400	80	1.5	15	6,000	1.5	20	100	400
Lactating (830 ml daily)				Add 1,000	100	2.0	15	8,000	1.6	25	150	400
Infant†	0 1/12‡ 1 1/12 § 4 1/2 § 10 1/2 §	6 (13) 9 (20) 10 (22)	60 (24) 70 (28) 75 (30)	kg × 120 kg × 110 kg × 100	kg × 3.5‡ kg × 3.5‡ kg × 3.5‡	0.6 0.8 1.0	6 6 6	1,500 1,500 1,500	0.4 0.4 0.5	3 4 5	30 30 30	400 400 400
Children	1 3 4 8 7 9	12 (27) 18 (40) 27 (59)	87 (34) 109 (43) 129 (51)	1,200 1,600 2,000	40 50 60	1.0 1.0 1.0	7 8 10	2,000 2,500 3,500	0.6 0.8 1.0	6 8 10	35 50 60	400 400 400
Boys	10 12 13 15 16 20	35 (78) 49 (108) 63 (139)	144 (57) 163 (64) 175 (69)	2,500 3,200 3,800	70 85 100	1.2 1.4 1.4	12 15 15	4,500 5,000 5,000	1.3 1.6 1.9	13 16 25	75 90 100	400 400 400
Girls	10 12 13 15 16 20	36 (79) 49 (108) 54 (120)	144 (57) 160 (63) 162 (64)	2,300 2,500 2,400	70 80 75	1.2 1.3 1.3	12 15 15	4,500 5,000 5,000	1.2 1.3 1.9	12 13 12	75 80 80	400 400 400

\*In planning practical diets the recommended allowances can be attained with a variety of common foods which will also provide other nutrient requirements less well known; the allowance levels are considered to cover individual variations among normal persons as they live in the United States subjected to ordinary environmental stresses common thereto.

†These calorie recommendations apply to the degree of activity for the reference man and woman. For the urban white collar worker they are probably excessive. In any case the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight.

‡The recommendations for infants pertain to nutrients derived primarily from cow's milk. There should be no question that human milk is a desirable source of nutrients for infants although intakes may not provide the recommended levels of certain nutrients.

§During the first month of life desirable allowances for many nutrients are dependent upon maturation of excretory and endocrine functions. Therefore no specific recommendations are given.

Sound structure cannot be built without building material, proper in kind and in amount. Man can accommodate himself to an adequate intake for a certain length of time but eventually he will suffer if it is continued too long.

To simplify planning of the normal diet specific points should be remembered. These are included in the Recommended Daily Dietary Allowances (1953 revision) (Table 67).

TABLE 67A

The data here summarized from earlier chapters may be used for approximate numerical calculation as follows:

A man 6 feet tall		72 in. les
		40 cal. inch
		<hr/> 2,400 calories
Roughly 3000 calories		
If division between food stuffs is 15 per cent protein		
35 per cent fat, 50 per cent carbohydrate the calculation would continue		
3000 calories	3000 calories	
15 per cent	35 per cent	
<hr/> 440 protein calories	<hr/> 1050 fat calories	
11" approx gm protein	11" approx gm fat	
(each gm yields approx 4 cal)	(each gm yields approx 9 cal)	
3000 calories		
50 per cent		
<hr/> 1500		
	1 cal)	

The diet prescription (R) would then read

3000 calories, 112 gm P 137 gm F 375 gm C

It can be seen from these values that in the normal diet there is a rough ratio between the nutrients—approximately 1 gm P 1 gm F 3.5 gm C. These figures, if kept in mind, make it possible to discern whether a therapeutic diet is high or low in any of the constituents by reading the prescription. Furthermore, and very roughly, one can remember that for the adult man the value is not far from 100 gm for protein—an easy whole number to remember.

The protein levels based on 3000 calorie intake are roughly as follows:

7% protein calories	50 gm protein—low level
10% protein calories	75 gm protein—average level
15% protein calories	100 gm protein—generous level
20% protein calories	150 gm protein—high level
25% protein calories	200 gm protein—very high level

## I The calorie requirement

In the discussion of metabolism it is stated that calorie requirement varies with size, sex, occupation, and other factors. A



general average for a man doing moderate work is approximately 2,800 to 3,000 calories per day, and for a woman from 2,200 to 2,500. Weight loss or weight gain soon indicates need for increased or decreased calories (see Chapter 22, Weight Control). A simple calculation to approximate calorie requirement is to multiply the height of the individual in inches by 40 calories. Or, in the adult, it may be calculated as 35 to 40 calories for each kilogram of preferred weight (roughly, 25 calories under basal condition, 30 at bed rest, 35 at light exercise, 40 for moderate exercise, and 50 for severe activity). Supplying calories to meet the chosen weight naturally tends to bring the body to that weight.

## II The protein requirement

Protein level is the second point in importance. High and low protein intake have both been advocated. An intake of protein well above the metabolic requirement, but below the extremely high levels, seems the most desirable. On the average present day diet the protein supplies from 10 to 15% of the total calories or approximately 1 gm per kilogram of body weight at a 10% level, which is 70 gm for the average man, and 15 gm at a 15% level. It is wise never to permit the level of protein intake to fall below 0.7 gm per kilogram, or a total of 50 gm daily. If this occurs insufficient protein is supplied to meet the daily wear and tear of body tissues, the tissues themselves are burned, and protein deficiency occurs. Even when theoretically the lowest possible protein intake is desired, an intake below 0.7 gm per kilogram may result in symptoms as harmful as those the diet was planned to alleviate. When a low level of protein is used, proteins of high biological value (animal proteins, such as milk, cheese, eggs, meat, fish and poultry) should be ingested. If the proteins of low biological value are substituted, a specific deficiency of one or more of the essential amino acids may result (see Chapter 5, Proteins).

With the higher protein intakes (as high as 2 to 4 gm for a child) some protein of lower value (beans, peas, lentils, gelatin, etc.) can supplement the animal group.

One authority suggests a distribution of protein as follows: 19% milk, 28% meat, 18% eggs and cheese, 16% fruits and vegetables, and 19% from cereals—or one third from vegetable

sources and two thirds from animal sources. However, an equal amount of animal and vegetable protein is a practical and safe proportion and is more economical if this is a factor

### III The fat level

In the normal diet, fat supplies 25 to 45% of the total calories, 75 to 150 gm daily, or 1 to 2 gm per kilogram of body weight. Since carbohydrate more effectively spares body protein than does fat, and since fat in too large amounts may not be well tolerated, a fat intake not to exceed 45% of the total calories is preferable to a higher intake, unless the higher intake is specifically indicated.

The higher the fat, the more costly the diet. When strict economy must be practiced the diet must necessarily be of high carbohydrate content.

Changes in the quantity of fat in the diet may be a means of regulating appetite, since the higher the fat content of a meal the longer it stays in the stomach and the longer hunger pangs are deferred.

### IV The carbohydrate intake

Carbohydrate normally supplies roughly 40 to 50% of the total calories, from 4 to 5 gm per kilogram or a total of 300 to 400 gm. Starches form the bulk of the carbohydrate eaten. They are the cheapest source of energy and are neutral enough in flavor to be well adapted to liberal use. The cereals, cereal products such as breads etc. and the 15 to 20% vegetables are the chief sources of starch. The fruits, sugars and desserts supply the sugar.

### V The minerals

While no one mineral is of greater importance than another (see Minerals, Chapter 13), in general practice only three require calculation to assure adequate intake. These are calcium, phosphorus, and iron. Sufficient protein in the diet insures sufficient sulfur. Sodium and chlorine are provided in excess as seasonings. The potassium content of vegetables is high. But deficiencies of calcium, phosphorus and iron do occur. Standard or optimum intake values which are sometimes suggested, include a margin of safety. The optimum is the minimum requirement of these constituents plus 50%.

For children the calcium and phosphorus should be 1 and 15 gm, respectively. Milk must be included for the phosphorus and calcium. All the calcium and half the phosphorus are supplied by three fourths quart of milk.

## VI The Vitamins

Even though the specific deficiency diseases seen in animals are rarely encountered in man, lowered resistance to infection and numerous vague clinical symptoms are known to be attributable to low vitamin intake. It is entirely possible to meet the normal vitamin requirement with the exception of vitamin D, by means of food.

*Vitamin A* is abundantly supplied by cream, butter, cheese milk, highly colored fruits and vegetables, liver, egg yolk, and salmon. If the diet contains a pint of milk, a serving of butter, a leafy or colored vegetable and fruit, a protein such as cheese egg, liver, or a dark colored fish the vitamin A requirement of the normal individual will be met.

*Vitamin B* This group may, for simplicity, be considered together. Liver, whole grain cereals, milk, molasses, and yeast yield good amounts of vitamin B while vegetables, fruits, and nuts are appreciable sources of all of this group. If the daily food contains a pint of milk, a whole grain, or enriched cereal a serving of fruit, a leafy vegetable, and a serving of meat (particularly liver), the B group of vitamins will be supplied in adequate amounts.

*Vitamin C* is obtained in excellent amounts from the citrus fruits. An orange or half a grapefruit contains nearly enough to meet daily requirements. (The frozen and canned juices have essentially the same vitamin C value as the fresh fruit.) Cabbage, cauliflower, broccoli, strawberries, and raspberries are excellent sources, and most fresh vegetables and fruits are good sources. Raw vegetables should be used where practical. Salads are rich in vitamins.

*Vitamin D* is rather restricted as to natural sources. It is the one vitamin that requires supplementation by commercial products during the period of growth especially when sunlight is not available. A fish oil should be considered as food in the diet of the child not as medication.

The other vitamins of which we hear are still undergoing experiment and as yet need cause no concern. Physiological ailments from their lack have not yet been proved. We may well assume that since they are closely associated with the familiar vitamins sufficient amounts of the one group will insure the presence of adequate amounts of the other.

Vitamin K deficiency occurs only when faulty absorption of fat exists or there is liver dysfunction of such nature that the vitamin is destroyed. If the diet contains an abundance of green leafy vegetables deficiency could result from such pathological change only.

## VII Water

Water plays an important part in good nutrition. It is available to the body from three sources: ingested as such or as tea, coffee, fruit drinks and other beverages; as preformed water which is part of the composition of the food (milk is 87% water, fruits and green vegetables 75 to 90%, ready-to-serve cereals contain 10%) and last the metabolic water which results in the oxidative breakdown of food (see Chapter 1, Water Balance). In general the intake of fluids as such should not fall below 1000 cc (1 quart) per day.

## VIII The indigestible fiber content of the diet

Indigestible fiber is necessary if normal intestinal activity is to take place. There is general agreement that abundant fruits and vegetables should be included in the normal diet. The cellulose framework of these foods resists digestion in man and is eliminated from the body as roughage. Just how much roughage should be supplied is a question. In certain types of constipation roughage is undesirable. The use of the new enriched, restored or reinforced milled flours and cereals assure products with a vitamin potency equal to the whole wheat flour but devoid of roughage. The quantity and quality of indigestible fiber to be included in the diet must be settled by individual experimentation.

## IX The acid base balance

Certain foods because of their mineral content leave an acid ash or produce an acid urine. Other foods leave an alkaline ash

as the end product of metabolic process. The determining factor is the predominating mineral (see Minerals, Chapter 13).

Foods are classified as acid forming or base forming. Meat, fish, eggs and cereals are acid forming. Milk, vegetables and fruits, with the exception of prunes, cranberries, and plums (see Minerals), are base forming. Fats, sugars, and starches are neutral. The normal diet should be neutral or slightly alkaline. Original organic acidity, such as the tartness of oranges, due to their citric acid content, should not be confused with the acidity as an end result of metabolism.

### X Food idiosyncrasies

Unnatural food habits may be due to notions or to food allergies. If they are due to the former, psychological adjustment should be undertaken. If to the latter, the allergy should be strictly observed. When, however, a food which is a dietary essential must be omitted from the diet, *it is imperative that it be replaced by some other satisfactory food or commercial product which will offset the elimination of the particular food.* Allergy may seriously alter meal planning (see Chapter 41).

### XI General

The attractiveness, palatability, suitability, and cost of any diet are matters of importance. In addition, general eating habits, health habits, physical surroundings and psychological response can, if they are adverse, offset many advantages of a proper diet.

Gove Hambidge says in *Your Meals and Your Money*\*: "After all the analysis and pulling apart has been done perhaps the larger significance of food study lies in three things. It seems to indicate very clearly. That diet is a primary factor in enabling the individual to realize the highest physical well being of which he is capable within the limitations of his inheritance. That whatever specific factors are responsible for specific results it is the whole picture that counts, the whole diet, the whole body, and the whole life. That to attain the really profound effects of a superior diet takes a lifetime or even more than one generation. All this opens up a new point, a sweeping panorama in

\*Published by McGraw Hill Co. New York N. Y.

deed and a new field of effort to the science of nutrition and by the same token as Sherman has pointed out it greatly increases the responsibility of the nutritionist in relation to human welfare. Nobody has ever tried feeding a nation like a herd of thoroughbred animals just to see what would happen but I should like to see America start trying it."

## CHAPTER 25

### PLANNING THE FAMILY DIET

We know from scientific studies what is essential for normal, optimum nutrition, but how shall the meals be planned? This is not a complicated matter. The daily or weekly inclusion of certain basic foods or food groups is assurance that fundamental requirements will be met. After these foods have been included, the remainder of the diet may be made up from foods of choice.

The first essential is milk. If the daily diet contains 1 quart of milk, there is at once protein of the highest quality, fat, and carbohydrate (see Chapter 5). All the calcium needed, two thirds the requirement of phosphorus, one third the needed vitamin A, one half the requirement of vitamin B<sub>1</sub>, and over half of the vitamin B<sub>2</sub> will be present. If only a pint of milk can be included each day, it will go a long way toward meeting requirements, but not in optimum amount.

The milk may, of course, be drunk as such or made into cocoa cream soups, puddings, sauce for vegetables, or it may replace water in preparing cereals. Cheese may be used to replace part of the milk intake. The cheese equivalent of 1 quart of milk is approximately one fourth pound, depending upon the texture. When cheese replaces milk, however, it must be remembered that part of the minerals, the water soluble vitamins, and the major part of the carbohydrate have been lost in the whey if the cheese is one made from curd alone. If skim milk cheese is used, there is additional loss of cream or fat.

Other equivalents for the quart of milk are the pint can of evaporated milk (16 ounces), 4½ ounces of dried whole milk, or 3½ ounces of dried skim milk plus 1½ ounces of butter.

As a second essential, a cereal or cereal product should be eaten every day in addition to bread. Breakfast foods today offer a wealth of choice. We have wheat, oats, rice, corn, barley, buckwheat and rye in their natural state, as well as the multiplicity of prepared cereals. Besides the breakfast foods we have a great variety of pudding materials, tapioca, rice, sago, corn, and others, and in addition to bread we have muffins, rolls, biscuits.

waffles, griddlecakes and crackers. Choice should be a pleasant task. The preference should be for the whole grain or enriched cereals or cereal products. As has been stated before the outside husk is removed in the finely milled cereals; consequently the minerals and vitamins are no longer present. Such cereal is of value only as a source of calories, small amounts of incomplete protein and for its satiety value. With the possible exception of wheat and oats, the husk of most cereals is not too rough to prevent its inclusion in the normal diet. The bran layer of wheat millets may be contraindicated for some individuals. To compensate for this, however, wheat germ may be used separately or enriched milled flour may be purchased. Wheat germ is rich in the vitamin B complex and in minerals, but has very little indigestible fiber.

The cereal group is, of course, of high caloric value and because of its blandness may be included in good quantity. In addition cereals furnish indigestible fiber to varying extent (when not finely milled) and are a source of phosphorus, sodium, magnesium, sulfur, and all the vitamin B complex. Three to four servings during the day as a cereal or "bread" are desirable.

The third essential is **vegetables** of which there is a variety. The leafy green salad vegetables are rich in minerals and vitamins (A, B complex, C, E, and K) but are low in protein, fat and carbohydrate. In fresh raw salads they retain their vitamins and minerals. If they are cooked, care must be exercised to prevent dissolving out the minerals and water soluble vitamins. One green leafy vegetable should be included in the diet daily as a salad unless a raw fruit salad or raw fruit alone is served. A second vegetable should always be included in addition to potato—or a total of three, one of which should be raw, if possible. In general the vitamin and mineral content of these last mentioned vegetables is low, but their caloric value is higher and unless a low caloric diet is desired these vegetables add variety, color and satiety.

**Fruits** are similar in composition to the vegetables, the difference being largely a matter of sweet carbohydrate (sugar) in place of starch. To insure adequate intake of vitamin C it is wise to include routinely a citrus fruit in the daily diet if cost permits and if there is no sensitivity (allergy) to citrus fruits.



## CHAPTER 25

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Other equivalents for the quart of milk are the pint can of evaporated milk (16 ounces), 4½ ounces of dried whole milk, or 3½ ounces of dried skim milk plus 1½ ounces of butter.

As a second essential, a cereal or cereal product should be eaten every day in addition to bread. Breakfast foods today offer a wealth of choice. We have wheat, oats, rice, corn, barley, buckwheat, and rye in their natural state, as well as the multiplicity of prepared cereals. Besides the breakfast foods we have a great variety of pudding materials, tapioca, rice, sago, corn, and others, and in addition to bread we have muffins, rolls, biscuits.



If the citrus fruit cannot be included, the need for salads and carefully cooked leafy vegetables and tomato (either raw or cooked) is increased. One serving of citrus fruit, grapefruit or orange, nearly meets the day's requirement of vitamin C.

Apricots, peaches, and, to a lesser extent, prunes have a place all their own among the fruits. They are effective in hemoglobin regeneration, quite out of proportion to their mineral content. For this reason, the inclusion of these fruits in the diet once a week or more is wise. A second fruit daily is highly desirable. Use fruits as dessert, at least part of the time.

**Meat.** It is possible to have the diet adequate in protein if ample milk, cheese, and eggs are included, but for satiety value nothing replaces the occasional use of meat. To include meat daily greatly enhances the palatability and the food value of the diet. Meat is an excellent source of protein, minerals and the B vitamins. With the variety in cuts, combinations, and methods of cooking, no monotony need exist.

**Fish** and meat are essentially interchangeable (see Proteins Chapter 5). The iodine content makes the use of salt water fish at least once weekly, desirable.

**Liver** is considered separately from meat because it is meat de luxe from the standpoint of nutrition. It has all the constituents present in other parts of the carcass, and, in addition, has a higher vitamin B potency, is a valuable source of vitamin A, and has no superior in any form as a blood regenerating food. Liver revolutionized the treatment of anemia, and while it is rarely possible for a person to eat enough liver, as such, to control pernicious anemia, its concentrates are the most valuable form of medication in this disease, and certain amounts of liver in the diet are extremely important. Liver should be served weekly in the normal diet. The only difference in nutritive value among calf, beef, lamb, and pork liver is a variation in iron content and there is also a difference in the palatability and in the cost. The milder the flavor (calf liver) the higher the cost. It is essential that the liver juices be preserved in preparing liver for the table. Soaking or parboiling to remove the strong taste also removes minerals and vitamins and this practice should be avoided.

Eggs should be served daily if possible. The yolk contributes vitamin A in good amount, vitamin B<sub>2</sub>, and is one of the few food sources of vitamin D. The yolk also contains lecithin, essential fatty acids and iron. The white is pure albumin. If eggs cannot be used daily, at least three a week should be consumed by the individual. Boiled, fried, scrambled, made into puddings, cakes, etc., they play their part however they are used.

Fats contribute calories to the diet, but in the basic diet they are important also for their vitamin, cholesterol, lecithin, and essential fatty acid content. Animal fats contribute vitamin A. Butter, cream, and fish oils contribute vitamin D. The seed oils, such as cottonseed (Wesson) and corn oil (Mazola), furnish the unsaturated fatty acids, vitamin B<sub>6</sub> (pyridoxine) and pantothenic acid. Therefore a generous serving of both butter and salad oil daily is important.

After the particular forms of food here mentioned have been included in the diet, other foods according to fancy may be included to contribute the additional calories. The foregoing basic diet will contribute about 1,000 calories. These foods are found in the *Basic Seven Food Groups* (see Table 68). This **Yardstick of Good Nutrition** is a streamlined version of the recommendations of the Food and Nutrition Board (see Chapter 2). This suggests that certain items be chosen each day from specific food groups and that a variety of foods be chosen over the week. Such choice assures adequacy of diet and conformation of the detailed standards (see Chapter 24) as can be seen readily from perusal of the groupings in Table 68. Such an instrument serves as a means of improving dietary habits without confusing the lay public with scientific details. Details and reasons must be more slowly acquired.

Fig. 63 illustrates how each of these food groups may contribute part of the essential nutrients to the total day's diet. These graphs represent the Basic Diet Plan of a 25-year-old (see Table 74, Chapter 27). Some nutrients are above the Recommended Allowances in order to provide foods containing adequate amounts of other nutrients which are not as plentifully distributed.

In planning the family diet many adjustments have to be made. These may be such factors as various age levels within

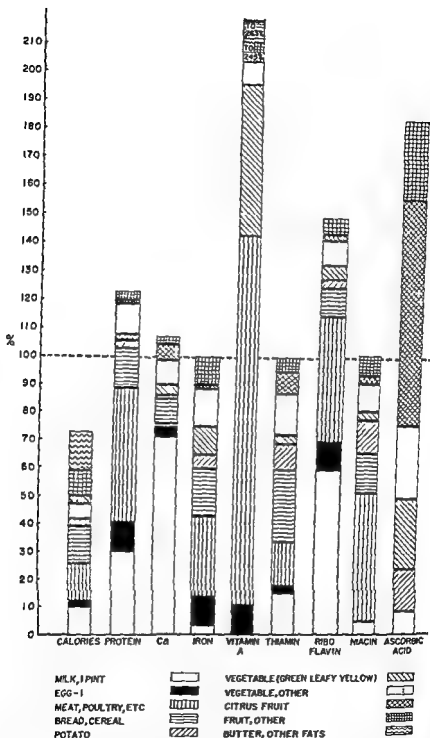


Fig 63—How the food groups from Table 74 (Chapter 26) combine to meet the nutritive needs of a 25 year old woman. Based on the percentage of each group of the daily recommended allowances. The diet supplies adequate amounts of all nutrients except calories

Each family and each member of a family has certain foods which are favorites other foods which are not served very often. Many food patterns are dictated by custom and cultural backgrounds (see Chapter 23). It is possible to include all of these variations in a weekly meal plan.

The result of a recent Gallup poll of American eating habits indicates how few actually have a diet which is scientifically considered and conducive to optimum health. The results of this poll showed—and we quote:

<i>Essential Foods</i>	<i>How Americans Are Eating</i>
1 Green or yellow vegetables	23% had none
2 Citrus fruit, tomato or raw greens	46% had none
3 Other fruits or vegetables	9% had none
4 Milk or milk products	32% had none
5 Meat, fish or poultry	9% had none
6 Eggs	40% had none
7 Cereal or bread	4% had none
8 Butter or other fats	22% had none

The relation of this survey to another survey on illness may be significant. This second survey showed that 16% of the total population or about 21,000,000 persons, in the United States were suffering from the common cold.

Recent reports of the number of man hours lost a year to various illnesses are tremendously large, estimated at about 1,500,000.

One of the most important influences in menu planning is the amount of money the family can budget for food. The diet plan in Table 69 may be used for any economic level. Some general principles can well be kept in mind to adjust it to different levels of income. For instance, cereals in bulk, which are still available in some regions, are less expensive than the packaged varieties. Cooking costs may be reduced by the use of a fireless cooker, by utilizing the top of a heating stove, or the ledge of the furnace. Lower priced cuts of meat are as nutritious as the expensive cuts, except where bone content offsets the lower price paid. In general cabbage, tomatoes, carrots, and potatoes are the cheapest vegetables, and there are none better. Seasonal buying is a factor here also. Many brands of canned goods offer no greater food value than cheaper brands. A knowledge of can sizes and brands often effects a saving. Canned or powdered milk may replace fluid milk, and skim milk may be substituted for whole milk (see Proteins, Chapter 5). As we have stated previously, legumes may replace in part milk egg meat protein. Cot

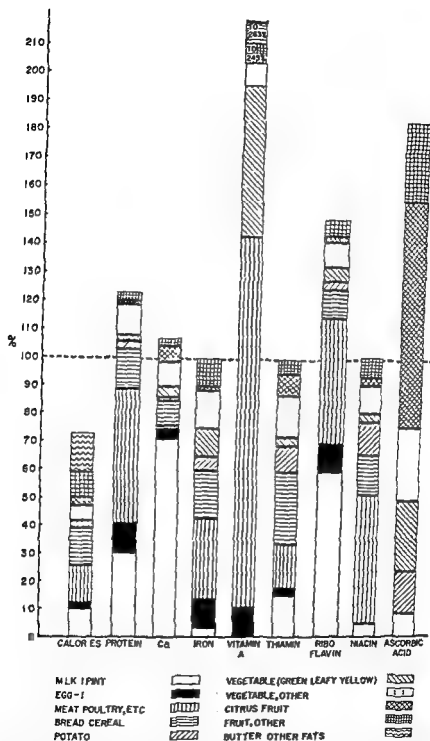


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TABLE 69  
A Food Plan for Good Nutrition  
(Quantities for one week)

KINDS OF FOOD	FOR CHILDREN 1 TO 6 YEARS	FOR CHILDREN 7 TO 12 YEARS	FOR GIRLS 13 TO 20 YEARS	FOR BOYS 17 TO 20 YEARS	FOR WOMEN		FOR MEN, ALL ACTIVITIES	TOTAL SUGGESTED FOR YOUR FAMILY
					ALL ACTIVITIES	INFANT AND UPSING		
Dairy, green, and yellow vegetables	2 1/2 lb	3 1/2 lb	1 1/2 lb	1 1/2 lb	3 1/2 lb	1 lb	3 1/2 lb	
(rus fruits, tomatoes)	2 2 1/2 lb	3 1/2 lb	3 lb	3 3/4 lb	2 1/2 lb	3 1/2 lb	2 1/2 lb	
Potatoes sweet potatoes	3 1 lb	1 1/2 lb	2 1/2 lb	1 1/2 lb	2 3 lb	2 3 lb	3 5 lb	
Other vegetables and fruits	2 lb	2 1/2 lb	3 1/2 lb	1 1/2 lb	3 4 lb	3 3 1/2 lb	3 4 lb	
Milk, cream, ice cream (milk equivalent)*	6 qt	7 qt	6 7 qt	7 qt	5 qt	7 1/2 qt	5 qt	
Meat poultry, fish	2 1 1/2 lb	2 lb	2 1/2 lb	3 lb	2 1/2 lb	3 lb	3 1/2 lb	
Eggs	6 7 eggs	7 eggs	7 eggs	7 eggs	6 7 eggs	7 eggs	6 7 eggs	
Dry beans and peas, nuts	1 oz	2 oz	2 oz	4 0 oz	2 4 oz	2 oz	4 oz	
Other foods, flour cereals (flour equivalent)*	1 1 1/2 lb	2 1 lb	2 1 lb	4 5 lb	2 1 lb	2 1 1/2 lb	3 7 lb	
Whole grain, enriched, or restored								
Fats, oils	1 1/2 lb	1 1 lb	1 lb	1 1 1/2 lb	1 1 lb	1 lb	1 2 lb	
Sugar, syrups, preserves	1 1/2 lb	1 lb	1 lb	1 1 1/2 lb	1 1 lb	1 lb	1 1 1/2 lb	

\*1 or explanation of milk equivalent and flour equivalent foods see text

†Lower quantities are for the younger girls

To meet the iron allowance needed by children 1 to 6 years girls 13 to 20 and pregnant and nursing women include weekly 1 jar of small servings of liver or other organ meats

From Nutrition Up to Date Up to You U S Department of Agriculture Bureau of Human Nutrition and Home Economics February 1950

tage cheese is cheap and contributes valuable protein. Oleo and nut margarines if reinforced with vitamin A may replace butter and are much less costly.

Dry old bread instead of freshly baked offers a saving. The home baking of cakes and cookies and the preparation of puddings in the home rather than the use of packaged products is usually less costly. Prolen cereals, broken rice, etc. are cheaper than the whole products.

However, if the diet were forced to the monotonous level of whole grain cereals, whole mill, and raw cabbage it would be surprisingly adequate if taken in sufficient amounts, as calculation of its content indicates. Not desirable of course but possible.

Radio programs, newspapers, and sometimes television programs provide information about the local prices so that the homemaker is aware of good buys and fluctuations in price. An alert shopper manages the purchase of foods as carefully as a business is administered.

Menus may be made more appealing by keeping in mind certain factors in the planning. For example, the colors of foods should harmonize. A colorless meal can be colorless indeed as to taste just as a clash of colors may detract from palatability. Cold foods should be served cold and hot foods hot and the temperature of the meal suited to the outside environment. No meal should consist of all soft foods or all chewy foods. A combination of crunchy and soft foods in the same meal makes the food more interesting. Monotony of texture should be avoided as much as monotony of color.

Foods bland in flavor are better if alternated with those having snap as to flavor. Variety will lend appeal and no one food stuff should be predominant.

We have endless flavorings, spices and garnishes (parsley is not the only one) and meals become attractive looking from this standpoint with little effort.

Concentrated foods are better coupled with bulky foods; it total bulk and calorie balance are to be maintained.

Do not serve the same food twice the same day. Dress the leftovers up differently for another day.

Except in extremely hot weather, it is well to plan a hot drink or hot dish for every meal, even hot biscuits or hot rolls for the sake of variety

Fresh vegetables, fruits, and fish served in season taste better and give added zest to meals when their particular season arrives

When the diet needs adjustment other than to environment let it be made carefully and with an understanding of the metabolic dysfunction, and with due consideration of the patient as a person with rights and privileges. Insofar as these are compatible with his nutritional welfare they should receive attention

In many diseases diet does not need adjustment (see specific discussions), but it must always be remembered that first and foremost *the individual has a body which must be maintained in as nearly perfect a state of nutrition as is possible, and second, that due to some abnormality, certain foods may not be used in normal fashion. Only such foods as require alteration in kind or amount should be changed and after such a change is made, there should be assurance that a dietary deficiency will not result which may be as serious as the disease the diet is designed to alleviate*

Dr Alvarez aptly expressed the need for sound dietetic information when he said that the pressure of opinion produced by the campaign for vitamins, roughage, green and raw foods was so great that it could be withstood only by a determined and thoughtful person who was well supplied with facts

All peoples regardless of cultural background economic or social status or personal characteristics require the same kind of food, for body needs do not change. But all these varying circumstances must be taken into consideration at times in planning the diet. Environment and state of health also exert modifying effects. With thought it is usually possible to secure adequate food intake in any of these circumstances, but too frequently diets needlessly fail of their purpose. No diet will be long tolerated which departs radically from habits of years' standing, is difficult to obtain under existing living conditions or under the economic limitations of the individual, or which may make him conspicuous. Any diet planned for the normal

the chronically ill, or the acutely ill person must be flexible enough to permit adjustment within the major food groups so that food familiar and appetizing to the individual may be utilized

In Part V are listed several excellent publications invaluable to the food planner when she is faced with the many factors which arise to make necessary adjustments in the diet

## PART III

# MODIFICATIONS OF THE NORMAL DIET

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### CHAPTER 26

### THE PATIENT

The current trend in therapy is to consider the patient as a whole person in dynamic interaction with the forces that comprise his social setting. Thus, those who are concerned with helping the patient must interest themselves with the details of his environment as well as the symptoms of his physical ailment. For example, a patient whose cooking facilities were limited to a one burner hot plate might be blithely told to "only broil or roast meats," if this information were not obtained.

From this modern approach to patient therapy has evolved the concept of the "therapeutic team." Each member of the team, the physician, the medical social worker, the nurse, the nutritionist, the laboratory technician, pools his specialized knowledge of the patient, and from this aggregate information the total treatment of the patient is prescribed by the physician. It is not possible to always have all of these specialists in each situation. Often, the nutritionist, the medical case worker, the nurse and the laboratory technician are available to the physician only on a consultation basis. However, in so far as possible, the approach to the therapy of the patient usually follows the several pathways represented by each of these specialties instead of isolating his medical condition from his social setting which was often the practice in the past. This may be true if the therapeutic team is a "one man team" (the physician) or a team composed of many specialists.

Before any specific diet therapy is prescribed for the patient it is believed necessary to evaluate his present nutritional status. This evaluation may be obtained through four separate areas of investigation: the nutrition history, the clinical examination, the medical examination and the laboratory examination. When ever possible all are performed and, when the information from

each are "pooled" a fairly comprehensive indication of the patient's nutritional status is secured. The medical and the laboratory examinations are beyond the scope of the present book and so they will only be mentioned briefly. The clinical examination is of related interest and consequently will be discussed. The nutrition history is of primary importance and will be presented in detail.

The purpose of the nutrition history is to discover the usual food pattern over a relatively long period of time. This may be contrasted with the diet record and the recall method which aims to obtain information about the amounts of foods eaten within a specified time. Since the amounts of food recorded are only estimates it has been found that the patient in his notations usually underestimates the food consumed. The time period is also one of the areas of greatest error in the diet record and recall method. Records of several days or recalls for 24 hours do not provide a basis for generalizations about the patient's regular diet. However these methods can be used most advantageously as a foundation for nutrition education.

A third type of evaluation of nutrition intake is that used primarily for research. This constitutes accurate weighing of the food eaten by the patient either by the patient himself or the investigating personnel.

A fourth and still more refined method of ascertaining nutrient intake is by chemical analysis. Food which is duplicated in every respect (including weight) is determined by analysis for nutrient content.

For the most part the nutrition history with perhaps a 24-hour recall as a cross check or contrast is the most acceptable means of obtaining the usual food intake of a patient. Not only does it reveal major deviations from the universally held concept of good food habits but it can also provide a basis for nutrition education. When other examinations the medical clinical or the laboratory have indicated that a nutritional deficiency might exist an examination of the dietary intake of the patient may indicate whether or not the condition were related to the ingestion of nutrients. Jolliffe has indicated that a rapid evaluation of the dietary pattern in qualitative terms (the nutrition history) would be all that is really necessary in the office hospital, or

clinic The basic seven is often used as a standard with which to evaluate the nutrition history of the patient

There are many nutrition history forms which are used by clinics or hospitals Each one has been compiled with the needs of the specific institution in mind However, as indicated previously, it is necessary to obtain information about the environment, such as the home, working conditions, economic status and background of the patient, as well as specific information about his food habits Table 70 represents a possible nutrition history form The interviewer asks the questions and notes the answers in the proper place, the patient does not "fill out" the form Thus, not only is it important to learn what the patient is in the habit of eating, but it is equally necessary to know how he eats, where he eats, when he eats, and the possible range of his eating pattern

An effective nutrition interview is quite difficult It takes considerable practice and skill to conduct an interview so as not to suggest a desired answer and to obtain accurate information As Babcock pointed out, the interviewer must be flexible and must have a warm and unjudging attitude The nutritionist (or any one else conducting the interview) will be able to secure important information if she is aware of the differences in dietary practices that might exist from one ethnic group to another, and from one social situation to another (See Chapters 1 and 23) The nutritionist should realize that the patient may be anxious, tense, and apprehensive about his physical ailment Through out his nutrition interview, the patient may express this anxiety in many ways He may seem physically uneasy and restless He may break forth in self conscious laughter or, conversely, he may maintain an uncompromising silence If the nutritionist realizes that these manifestations are not an expression of personal animosity, his anxiety can perhaps be redirected toward an active participation in his own interest Thus, by conveying to the patient sincere sympathetic understanding the nutritionist can put the patient so at ease that she can obtain useful information and encourage the patient to be receptive to any necessary dietary adjustment

The nutrition interview contains such valuable information that it should become part of the patient's medical record This is done in many hospitals and clinics Likewise, the physician's

TABLE 0

## NUTRITION HISTORY AND RECORD

Name	History No	Sex	Date
Address	Age	(1 & new)	M S W D Sep
Telephone (home)			
Occupation	Hr/wk	Travel hr/wk	
Height	Actual weight	Ideal weight	
<b>Medical Information</b>			
Sleep av hr/nt	Mel cat on	yes	Smoke? yes
during day		no	no
	Type		pk/da
Gastrointestinal	Vitamin preparation		Recreational activity
constipation	yes		1 r/da
elimination	no		1 r/wk
gas	Type		Type
diarrhea			
Have you ever had any illness other than childhood communicable diseases?			
Yes	No	When?	
Did you ever have an operation?			
Yes	No	Describe	
Are your teeth in good condition? Yes No Dentures			
<b>Family Information</b>			
Number in family	Adults	Children	
Type of dwelling	Apt	House	Room
Family eats together	Breakfast	Lunch	Dinner
Does family have large get togethers?		Weekly	Monthly
If you have guests in the evening do you serve		cake or dessert	
fruits	sandwiches or delicatessen		candy
Who prepares meals	Mother	Grandmother	Self Other
Who shops for food?	Mother	Father	Grandmother
Self	Other		
Are other members of your family of normal weight according to height weight tables? Yes No Weight			
<b>Food Habits</b>			
Where do you eat	Breakfast (B)	Lunch (L)	Dinner (D)
Midmorning	Midafternoon	Mid-evening	
How much time do you allow for	B	L	D
Do you eat each meal at the same time each day? Yes No			
Do you have a good appetite? Yes No			
Do you eat meals alone?	B	L	D
How many times a week do you omit	B	L	D
Do you budget money for our food?	Yes	No	Be careful
Do you have an allergic feeling between meals?	Yes	No	Yes No
Do you take extremely hot foods?	Yes	No	Sometimes
cold foods?	Yes	No	Sometimes
Highly spiced foods?	Yes	No	Sometimes
Are you a candy eater?	Yes	No	Amt/da
Are you fond of rich foods such as ice cream cakes pastries etc?			
Yes	No	Amt/da	Amt/wk
Do you smoke immediately before eating?	Yes	No	
Do you smoke during meals?	Yes	No	
Do you chew tobacco?	Yes	No	Amt/da
Do you drink coffee during the day?	Yes	No	Amt/da



TABLE 70—CONT II

<i>Food Intake</i>		<i>Summary of Intake</i>	
		<i>Food</i>	<i>Total</i>
<i>Morning</i>		Milk—fresh	
Fruit		canned	
Cereal		dried	
Eggs		Cheese	
Meat		Eggs	
Bread		Meat	
Butter		Fish	
Beverage		Legumes	
Sugar		Bacon	
Cream	or Milk	Cream	
<i>Additonal</i>		Butter	
<i>Noontime</i>		Oil—other fat	
Soup		Fruit—raw	
Meat or		cooked	
meat substitute		Veg—raw	
Potato		cooked	
Vegetable—Raw		Potatoes	
Cooked		Potato substitute	
Bread		Cereal—refined	
Sandwich		whole grain	
Butter		Bread—refined	
Dessert		whole grain	
Beverage		Crackers	
Sugar		Sugar	
Cream	or Milk	Desserts	
<i>Additional</i>		Miscellaneous	
<i>Night time</i>		Tea	
Soup		Coffee	
Meat or Fish		Alcoholic beverages	
Potato		Water	
Vegetable—Raw		Vitamin medication	
Cooked		<i>Foods omitted and why</i>	
Bread			
Butter			
Dessert			
Beverage			
Sugar			
Cream	or Milk		
<i>Additonal</i>			

diet prescription and the diet which the nutritionist and the patient worked out should also be included. The subsequent nutrition interviews which indicate the patient's progress are usually noted on the medical record.

Because the teacher, the school nurse and the mother are in daily contact with children in school (or the public health nurse with the patient) symptoms of early deficiency diseases may be detected by others than the physician. In 1942 an excellent summary of clinical criteria of early deficiency disease symptoms in human beings appeared in the February and March issues of the *Journal of the American Medical Association*. The data were

adapted for the 1 edition of Nutritional Charts compiled by the H. J. Heinz Company. These outlines reproduced by permission appear in Table 71.

In discussing the detection of nutritional deficiencies by clinical examination Jolliffe in *Clinical Nutrition* suggested the evidence be treated cautiously for the following four reasons: (1) for the most part the deficiency signs are nonspecific and they can be provoked by factors other than malnutrition; (2) malnutrition may occur in persons who have eaten diets which may be considered adequate; these symptoms may be brought about by such things as interference with digestion, absorption or utilization or increased nutrient needs and so on; (3) there is a difference between acute and chronic lesions; and (4) deficiency diseases are frequently multiple and therefore the condition is a complex picture.

Thus the nurse or the teacher using the information set forth in Table 71 as a guide may detect an indication of a condition out of the ordinary and thereby quickly refer the individual to the physician for early treatment.

TABLE 71  
CLINICAL CRITERIA OF EARLY DEFICIENCY DISEASE SYMPTOMS IN  
HUMAN BEINGS

SYMPTOMS	PHYSICAL SIGNS
<i>Infants and Children</i>	
1 Lack of appetite (L) 2 Failure to eat adequate breakfast (L)	1 Lack of subcutaneous fat (N) 2 Wrinkling of skin on light stroking (N)
3 Failure to gain steadily in weight (L)	3 Poor muscle tone (D)
4 Late period of sitting, standing and walking (N)	4 Pallor (N)
5 Aversion to normal play (L)	5 Rough skin (tongue skin) (N)
6 Chronic diarrhea (L)	6 Hemorrhage of newborn (N)
7 Inability to sit (L)	7 Bad posture (I)
8 Pains on sitting and standing (L)	8 Nail blackheads and whiteheads (N)
9 Poor sleeping habits (L)	9 Sores at angles of mouth, cheilosis (L)
10 Backache in school (L)	10 Rapid heart (N)
11 Repeated respiratory infections (L)	11 Red tongue (D)
12 Abnormal intolerance of light photophobia (L)	12 Square head, wrists enlarged, rib beading (N)
13 Abnormal discharge of tears (I)	13 Vincent's angina, thrush (D)
	14 Serious dental abnormalities (N)
	15 Corneal and conjunctival changes—slit lamp (D)

TABLE 71—CONT'D

SYMPTOMS		PHYSICAL SIGNS	
Adolescents and Adults			
1	Lack of appetite (L)	1	Nasolabial sebaceous plugs (N)
2	Lassitude and chronic fatigue (L)	2	Sores at corners of mouth, cheilosis (L)
3	Loss of weight (L)	3	Vincent's angina (D)
4	Lack of mental application (L)	4	Minimal changes in tongue color or texture (D)
5	Loss of strength (L)	5	Red, swollen lingual papillae (D)
6	History of sore mouth or tongue (L)	6	Glossitis (D)
7	Chronic diarrhea (L)	7	Papillary atrophy of tongue (D)
8	Nervousness and irritability (L)	8	Stomatitis (D)
9	Burning, pricking of skin, parasthesias (L)	9	Spongy, bleeding gums (L)
10	Night blindness (N)	10	Muscle tenderness, extremities (D)
11	Abnormal intolerance of light, photophobia (L)	11	Poor muscle tone (D)
12	Burning or itching of eyes (L)	12	Loss of vibratory sensation (D)
13	Abnormal discharge of tears, lacrimation (L)	13	Increase or decrease of tendon reflexes (D)
14	Muscle and joint pains, muscle cramps (L)	14	Hyperesthesia of skin (D)
15	Sore, bleeding gums (L)	15	Bilateral symmetrical dermatitis (D)
16	Tendency to bleed (N)	16	Purpura (D)
		17	Dermatitis, facial butterfly Casal necklace, perineal, scrotal, vulval (D)
		18	Thickening and pigmentation of skin over bony prominences (D)
		19	Nonspecific vaginitis (D)
		20	Follicular hyperkeratosis of extensor surfaces of extremities (D)
		21	Rachitic chest deformity (D)
		22	Anemia not responding to iron (D)
		23	Fatigue of accommodation (D)
		24	Vascularization of cornea (D)
		25	Conjunctival changes (D)

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The detection of an early stage of dietary deficiency is important. Some signs are such as might be noticed by observant laymen such as parents or teachers for example others obviously require for their detection the more detailed knowledge and experience of a nurse still others will be seen and properly interpreted only by the skilled physician. The classification of symptoms and signs was prepared by the Subcommittee on Medical Nutrition Division of Medical Sciences National Research Council. The letters L, N and D in parentheses refer to layman, nurse and doctor respectively as the persons who might be expected to make the observation in question.

The medical or physical examination of the patient is conducted by the physician. While examining the patient the physician often finds evidence of malnutrition along with manifestations of other illness. Recently, Tollstette (in *Clinical Nutrition*) clearly and concisely discussed the pathogenesis of malnutrition. He defined a nutritional deficiency disease as 'one which was caused by a nutritional inadequacy'. Nutritional inadequacy results whenever adequate amounts of essential nutrients are not provided to tissues which require them for normal functioning'. He pointed out that there may be a primary nutritional inadequacy or a secondary or conditioned nutritional inadequacy. The former can be caused by a dietary inadequacy whereas the second may result from various factors which interfere with ingestion, digestion, absorption or utilization of essential nutrients. In addition increased requirements of nutrients or a destruction of nutrients may contribute to a conditioned malnutrition.

Tables 72 and 73 summarize the gross evidence of malnutrition, possible special examinations to aid in the detection of malnutrition and a listing of such factors which might bring about a conditioned malnutrition.

Disease is a chemical problem in which all possible influencing factors in its development must be considered. Whenever a deficiency is suspected of being a possible factor in the patient's symptoms the absorption and use of the nutritional elements and their quantitative intake should be evaluated. It is especially necessary to recognize the importance of the summation of several conditioning factors. Adequate dietary intake or adjustment to meet specific needs is probably of wider importance than is at present recognized.

The true deficiency diseases have been discussed in Chapters 11 and 12. These conditions as described and illustrated may not be frequently seen at such an advanced stage but subclinical symptoms or conditions which can readily be visualized as forerunners of these more advanced clinical pictures are not uncommon. Many vague symptoms characterized by indigestion, joint pains, fatigue, mild skin disorders, sore mouth, etc., can many times be shown to be subclinical deficiencies of vitamins or some other food constituent.

TABLE 72

*Gross Evidences of Malnutrition*

SYSTEM	FINDING	SUGGESTED DEFICIENCY OR SYNDROME
Eyes	Xerosis conjunctivae and corneae Central ophthalmoplegia	Vitamin A Thiamine
Mucous membranes	Scarlet red stomatitis and glossitis with or without secondary Vincent's infection Magenta glossitis Atrophic glossitis  Scurbic gums Cheilosis Nonspecific urethritis, balanitis, vaginitis	Nicotinic acid  Riboflavin Nicotinic acid, B complex, Addisonian anemia, Plummer Vincent syndrome Ascorbic acid Riboflavin Nicotinic acid
Skin	Pellagrous dermatitis	Nicotinic acid Riboflavin  Vitamin A Vitamin K, ascorbic acid Riboflavin
Neurological	Characteristic bilateral symmetrical polyneuropathy Combined system syndromes  Wernicke's syndrome Nicotinic acid deficiency encephalopathy Progressive stupor and hebétude Certain organic reaction psychoses	Thiamine  Thiamine, B complex, Addisonian anemia Thiamine, B complex Nicotinic acid Nicotinic acid Nicotinic acid, thiamine, and B complex
Skeletal	Rachitic deformities and osteomalacia	Vitamin D, calcium phosphorus
General	Underweight, underheight, edema, pallor	Calories, proteins, iron, B complex
Roentgenogram of hand and wrist, elbow and hip	Rickets and scurvy in children, osteomalacia and scurvy in adults	
Roentgenogram of heart	Advanced beriberi	
Electrocardiogram	Changes suggestive of thiamine deficiency	
Biomicroscopic eye examination with slit lamp	Capillary invasion of cornea (riboflavin deficiency), changes in conjunctivas (vitamin A deficiency)	

TABLE 72—CONT'D

*Special Examinations for Detection of Malnutrition*

EXAMINATION	CONDITION IT MAY DETECT
Red blood cell count Hemoglobin Stained blood smear Red blood cell volume	Iron deficiency anemia, Addisonian anemia, macrocytic anemia
Plasma ascorbic acid	
Serum calcium Serum phosphatase Serum phosphorus	
Blood pyruvic acid	Vitamin B <sub>3</sub> deficiency
Serum protein or albumin	Protein deficiency
Blood prothrombin	Vitamin K deficiency

The term *subclinical* is used to indicate that the complete picture of the deficiency is not present at the moment, but is potentially so, and it may be precipitated suddenly by some stress or strain (overfatigue, infection, pregnancy, etc.) or by a longer time interval itself. These symptoms frequently confuse the clinical picture and are added reasons for obtaining a complete dietary history.

After the detection of a possible nutritional deficiency, the diagnosis may be confirmed by either what is known as a therapeutic trial or laboratory examination. Therapeutic trial consists of supplying the suspected missing nutrient. A considerable amount of time may elapse before an improvement is noted. A laboratory examination may include tests upon the tissues, blood, urine or feces. As mentioned previously it is beyond the scope of this book to consider the number, the methods and the validity of such tests. It is sufficient to be aware of their contribution to the diagnosis of the nutritional status of the patient.

Thus, in order to consider the patient as a "whole" person, not his medical condition alone, information must be obtained about the factors that influence his environment. This can be acquired through the combined information gathered by the "therapeutic team." The influences which are related to the nutritional status of the patient may best be obtained from a nutrition history from a medical, clinical, and laboratory examination. Once the nutritional status of the patient has been de-

TABLE 73

*Factors Interfering With Ingestion*

- 1 Gastrointestinal disorders
  - Acute gastroenteritis, gall bladder disease, peptic ulcers, diarrheal diseases and obstructive lesions of gastrointestinal tract
- 2 Neuropsychiatric disorders
  - Neurasthenia, neurosis, psychoneurosis, psychoses, migraine, and neurological disorders interfering with self feeding
- 3 Anorexia
  - Alcohol, operations, anesthesia, infectious diseases, congestive heart failure, thiamine deficiency, visceral pain
- 4 Food allergy
- 5 Loss of teeth
- 6 Pregnancy
- 7 Therapy
  - Diets restricting ingestion of essential foods

*Factors Increasing Nutritive Requirement*

- 1 Abnormal activity, associated with prolonged strenuous physical exertion, delirium, and certain psychoses
- 2 Abnormal environmental factors
  - Excessively high temperatures, as in the tropics, in deserts, and in certain industries
  - Excessive light glare as from snow or klieg lights
- 3 Fever
- 4 "
- 5 "
- 6 " , parenteral dextrose solution

*Factors Interfering With Absorption*

- 1 Gastrointestinal diseases associated with hypermotility or reduction of absorbing surfaces
- 2 Achlorhydria
- 3 Biliary disease, especially obstructive jaundice
- 4 Vitamin deficiency
- 5 Therapy
  - Liquid petrolatum, colloidal adsorbents, severe catharsis, gastric and intestinal resections, and short circuiting operations

*Factors Interfering With Utilization*

- 1 Hepatic dysfunction, as in liver disease, diabetes mellitus, alcoholism
- 2 Hypothyroidism
- 3 Malignancy
- 4 Therapy
  - Sulfonamide drugs, radiation therapy, phenytoin

*Factors Increasing Excretion*

- 1 Polyuria, as in diabetes mellitus, diabetes insipidus
- 2 Lactation
- 3 Excessive perspiration
- 4 Therapy
  - Long continued excessive fluid intake, as in urinary tract infections

*Factors Increasing Destruction*

- 1 Achlorhydria
- 2 Lead poisoning? trinitrotoluene poisoning?
- 3 Therapy
  - Alkalis, sulfonamides, arsenicals

terminated, then the specific diet prescription may be based on the evidence gathered by these methods in order to correct past deficiencies and to prevent future ones

### Review Questions

1. What is meant by the concept of the "therapeutic team"?
2. Who might be the members of such a team?
3. How may the nutritional status of the patient be evaluated?
4. What is the purpose of the nutrition history?
5. What is the difference between the nutrition history, the diet record, and the recall method?
6. What are some of the limitations of each method of evaluating the patient's food intake?
7. What are five important points to keep in mind when conducting a nutrition interview?
8. What is the difference between a primary and a secondary nutrition deficiency and what might contribute to each one?
9. What is meant by the term "subclinical deficiency"?

### Suggested Project

1. Using the Nutrition History and Record Form in Table 70 conduct a nutrition interview with one of your colleagues. Carefully evaluate the experience in terms of such factors as how did the "patient" feel about the interview, how secure was the interviewer in the technique, how well do you think you know the patient on the basis of this interview, will you be able to adjust a diet, such as weight loss, to his diet pattern, and, if you were to do a second interview, how would it differ from the first?



## CHAPTER 27

### GENERAL SUGGESTIONS FOR DIET THERAPY

The present day concept of diet therapy is the modification of the normal diet. Unless the previous nutritional status and the kind, severity, and duration of the illness indicate otherwise, this is probably adequate for most patients. The normal diet may be modified in several ways. The general or "house" diets are usually modified in terms of physical consistency, i.e., light, soft, and liquid. In all diet therapy the patient is of primary importance so an individualized approach will insure food acceptance.

The primary objective of any dietary regimen is to either maintain or to bring about good nutritional status in the individual. The term diet therapy implies treatment by diet which will improve the clinical condition of the patient and still keep within the framework of this fundamental objective. Thus, treatment of any clinical condition must take cognizance of the fact that the patient's specific ailment is of no greater importance than the patient himself as an entity. All too often in the zeal to relieve a specific dysfunction, dietary restriction is such that deficiencies occur.

The changing concept in the philosophy of diet therapy reflects a concern for this often misguided enthusiastic but extreme restriction. Diet therapy originally was spoken of in terms of the "special diet" which usually suggested a "take away" situation. Today, the concept is based on a modification of the normal diet. Using a normal diet as a basis, diet therapy may modify the diet in physical consistency, in quantity of specific nutrients, in methods of service, in methods of preparation in flavor, and, last, the modification may be a combination of any or all of these variations. For example, a diet may be liquid, higher than normal in calories, fed through a tube, prepared in a blender, and with no added condiments. Whenever the modified diet is discussed in relation to a specific clinical condition, each one of these possible modifications will be considered.

Along with the changing concept in the approach to diet therapy an effort has been made to improve the nomenclature of the diets. Corinne H. Robinson as Chairman of the Diet Therapy Section of the American Dietetic Association reported at the annual meeting in 1951 the characteristics of good dietary nomenclature. Four desirable points in naming the diets were suggested:

- 1 Terminology should be related to the modifications of the normal diet i.e. it should be stated as an increase in one or more nutrients a change in consistency flavor etc.
- 2 It should specify nutrient levels whenever quantitation is essential to the success of the diet.
- 3 Reference to diseases or symptoms should be avoided in describing a diet.
- 4 Names of persons should not be used to designate a diet since the underlying principles are usually not clear.

It is true that many diet manuals have adopted these desirable characteristics. However the goal of diet therapy is to have as much as possible a universal understanding so that a Blind 500 mg. Sodium Diet will have the same connotation in Los Angeles that it has in New York.

As indicated in Chapter 26 the nutritional status of the patient should be ascertained before a dietary prescription is suggested. Various methods of determining this and several factors influencing nutritional status were suggested. In addition Pollack and Halpern in *Therapeutic Nutrition* (Bulletin No. 234 National Research Council) set forth the factors that determine the nutritional requirements of the hospital patient. These are:

- 1 The previous nutritional state of the individual
- 2 The nature and severity of the pathological abnormality present
- 3 The amount and character of the nutrient which is being lost from the body
- 4 The anticipated duration of the injury and disease

It should be kept in mind that the nutritional requirements will probably vary with each patient and the diet prescription should



be planned for each individual. However, after recognizing this point there are certain clinical conditions which alter the basic nutritive needs. These will be discussed for general application.

Many dietary regimens use the recommended dietary allowances of the National Research Council as the nutrients required for therapeutic diets. These allowances (Chapter 2) were meant to meet the needs of the *normal* individual. Therefore the use of these allowances should be restricted to a foundation upon which to build the various needs in diet therapy. Thus a basic diet should be set forth and then modifications made according to the four factors suggested by Pollack and Halpern which were cited above. Such a basic or normal diet has been calculated and will be used as a basis for modification throughout the Diet Therapy section. Table 74 represents the Basic Diet planned from the food groups discussed in Chapter 2 for the reference woman of 25 years. The diet plan meets the recommendation in all nutrients except calories. These could easily be added by the use of pastries, sugars, fats, starches and larger portions of the calculated food. These are usually included in the normal diet. It is of interest that it was necessary to increase the protein intake above the recommended amount in order to arrive at the needed iron allowance.

As was indicated, it has been suggested that the hospitalized patient probably has an increased need for many nutrients above that of the normal person. Little is known about the specific amount of each nutrient. However from the information available some recommendations can be made for modification.

It is important to see that patients do not remain in negative energy balance longer than necessary. Pollack and Halpern state that weight loss is *not* an inevitable result of disease or injury and can usually be minimized by sufficient attention to nutrition. A review of Chapter 7 will point out that if sufficient calories are not supplied by fats and carbohydrates then protein needed elsewhere will have to provide the needed calories either from the diet or from tissue protein. This in turn can use serious side effects. The caloric requirement increases with increase in the individual's activity. This is also true of the hospital patient. It has been shown that restlessness in bed may increase caloric expenditure by 10 to 20%. Specific conditions such as fever (see Chapter 29) increase the require

ment even more. However, the average adult afebrile patient with only a minor illness or injury at bed rest needs about 2 000 calories per day.

Although it is recognized that the protein needs of the patient are increased markedly in many clinical conditions, it has been suggested that the National Research Council recommended allowances could usually be considered adequate for those patients who are ambulatory or who are hospitalized for a short time. It is assumed that the protein be of high biological value and that it be consumed by the patient.

Because of the lack of research related to changes from normal requirements for vitamins in disease and injury, it has become an accepted procedure to supplement the diet up to as much as ten times the normal daily recommended allowances. From the limited evidence available, these quantities seem to be adequate for minor illnesses of approximately 10 days' duration. However, if the illness is severe, or such that the interrelationships among the nutrients are impaired, then an additional allowance may be needed. These are usually given in the form of supplements, as the amount of food which would supply this quantity of the vitamins perhaps would be beyond the ability of the patient to consume.

The electrolyte content of the body is one of the primary regulators of many processes. In many clinical conditions the normal functioning of one or more mineral elements are disturbed and, consequently, the present treatment often indicates a modification of the intake of that specific element in food. During periods of stress, abnormal demands are placed on the electrolytes within the body. These are special situations and will be treated in specific chapters. However, since most of the elements are so well distributed in foods it is doubtful if the ambulatory patient will suffer from a mineral deficiency, that is, provided he eats a "full tray."

Thus it can be concluded that for the present at least, if the patient has no fever, is suffering from a minor illness, is hospitalized 10 days or less, and ingests all his food he may be maintained in good nutritional status on a diet that includes the recommended daily allowances of a normal individual in his classification. It is assumed that he has sustained no nutritional deficiencies prior to the present illness. However, apart from

these severe limitations the majority of the patients have nutrient needs far beyond those of the normal individual. These will be discussed in each related chapter.

### The Standard Hospital Diets

Most hospitals plan menus for what is known as the 'standard' or 'house' diets. These represent the normal diet and modifications in physical consistency which might be used for many of the patients. These menus may also be modified in terms of preparation. The house diets provide a basis from which any additional modification such as in flavor in specific nutrients and in types of service may be made. The house diets include the following which are a progressive change in physical consistency: the regular or house diet (as it is sometimes called) the light diet the soft diet and low fiber diet and the full liquid diet. Some hospitals are routinely adding a 125 gm protein diet to their standard diets.

The regular or house diet is the normal diet which was discussed previously. Recognizing the need for personalizing the diet so that the patient will ingest the tray that is sent to him, adaptation of the normal diet is made for each patient in so far as possible. Many minor adjustments which take cognizance of his likes and dislikes such as milk for breakfast or an extra pat of butter with dinner will assure a receptive attitude toward any dietary regimen. The standard house diet can also be easily changed to meet individual calorie needs.

In some institutions specific meats and some vegetables are excluded from all hospital trays. Others have adopted a more progressive policy and include all foods on their standard menu. There seems to be a wide variety of opinion; however, the trend seems to indicate the acceptance of foods formerly prohibited. Clear cut experimental evidence that differences in variety exist is lacking. It is rather the method of preparation which seems to make a difference. Logically, unless the patient is suffering from a condition which prevents the proper digestion and absorption of foods, there seems to be no justification in depriving him of tasty, well prepared variety in trays.

The light diet is a slight modification of the normal diet. In many hospitals this classification does not appear in diet therapy. The degree of its modifications seem to vary from hospital to

hospital In general, it consists of what might be called the "simple" foods In terms of physical consistency, raw fruits and vegetables are prohibited, lettuce and tomato frequently being the only exceptions Cooked whole vegetables and fruits are allowed, as well as whole meats Doughnuts, pastries, fried meats and other fried foods, and highly spiced foods are withheld The light diet is the steppingstone between the soft low fiber diet and the regular diet

The soft low fiber diet is defined as "a diet modified in consistency, that is, including liquid foods and those solid foods which contain a restricted amount of indigestible carbohydrate and connective tissue" In planning the soft low fiber diet, a reduction in the amount of indigestible carbohydrate and connective tissue is of primary concern Indigestible carbohydrates are known as cellulose, hemicellulose, lignin, gums, pectins and mucin (see Chapter 3) These are found, for the most part, in the cell wall of plants

The indigestible carbohydrate of the normal diet may be reduced in many ways The use of refined breads and cereals thus excluding the whole grains and coarser cereals, is one modification The soft diet contains only cooked immature vegetables and fruits from which the seeds and skins have been removed This would include the elimination of jams and marmalades As indicated earlier, pectins and cellulose are disintegrated by cooking Further reduction of indigestible carbohydrate may be effected by puréeing fruits and vegetables If the purpose of the soft diet is not based on its reduction in fiber content but rather concerned with the fact that the patient cannot masticate easily, then the use of a blender to reduce the physical consistency of cooked fruits and vegetables may be warranted This often results in a more acceptable product than a purée

Connective tissue comprises the white or collagenous fibers and yellow elastic fibers called elastin which are found throughout the muscle tissue The amount of connective tissue found in any given cut of meat depends on the extent to which the muscle has been exercised and, to some degree, the age of the animal Generally speaking, the older animal has a higher percentage of connective tissue The relative tenderness of the meat is reflected

in the amount of connective tissue present; the less connective tissue the greater tenderness. Moist cooking at low temperature converts the connective tissue to gelatin and thereby alters its consistency. Meats may further be reduced in physical consistency by mincing or by scraping. It is also possible to buy pureed meats—lamb, beef, pork, veal, liver and heart. Each of these is a progressive step in the reduction of connective tissue in the soft diet.

Because of the rejection of pureed foods by the patient the trend in recent years has been toward the more liberal use of tender meats, refined cereals and cereal products and cooked whole skinless seedless immature fruits and vegetables. Such a menu can easily be adapted from the normal diet both in the hospital and in the home.

The **full liquid diet** is one that consists of foods that are liquid or that liquefy at body temperature. In some cases the diet must be of a consistency to pass with ease through a drinking tube. The liquid diet may also be further restricted to be only a **clear liquid diet**. This supplies fluids but is of little importance nutritionally as it usually contains only calories. The former the full liquid diet is the normal diet modified only in physical consistency and may be adequate nutritionally.

The clear liquid diet consists of fat free broth, tea, coffee without milk or cream, clear fruit juice or vegetable juice, sugar, gelatin and carbonated beverages. Ices without milk, jellied consommé and a combination of these foods may be included. In some hospitals the clear liquid diet contains egg white in various forms such as whipped with gelatin and in fruit juices. Obviously this regimen is nutritionally deficient and is used for only a short time.

There is no need for monotony in the full liquid diet if ingenuity and care are exercised in its preparation. The diet may be both palatable and adequate.

Milk is the major source of the protein of high biological value. Milk with slight padding could be made biologically adequate if it were not that the bulk necessary to meet caloric requirement would be too great. However using milk as the foundation it is possible to build up varied diets. For example 1 quart of milk plus 50 cc. of 40% cream and 50 gm. of lactose forms the 'milk cream lactose drink' of Coleman which yields 1000 calories.



The protein level of milk may be increased by adding powdered skim or whole milk, protein milk, Casec (calcium caseinate), gelatin, or egg, or any of the new high protein products may be used.

Milk drinks may be flavored in countless ways with chocolate, cocoa, vanilla, coffee, spices, molasses, etc. Dark cane molasses supplies approximately 1 mg. of iron per tablespoonful and is a source of vitamins B<sub>2</sub> and B<sub>6</sub> and pantothenic acid. Preparations such as Cal C Tose (Hoffmann-LaRoche), Dietene (The Dietene Company), Vitikon (Upjohn), and other similar preparations add variety, vitamins, and extra protein, vitamins, and minerals to milk drinks. Powdered yeast makes a valuable addition to any drink, and, if carefully prepared, may not be unpalatable. If Vegex, a yeast preparation, is added, or is used with any liquid, the drink will have a good store of the vitamin B complex.

Powdered milk, either whole or skimmed makes a valuable and inexpensive padding for milk. Roughly, 1 cup of the powdered milk added to a quart of the liquid milk results in a milk of double nutritive value. Or 2 cups of the powdered milk may be added. The resulting triple rich milk may also be used as such or be made into a variety of palatable drinks. The use of a blender often improves the texture (and, in turn, the acceptability) of these drinks. Various flavors, as indicated above, may be added.

Water or milk thickened with cereal becomes a gruel. Any cereal may be used—farina, oatmeal, rice, barley, corn, arrow root, etc. Instead of using the usual ratio of cereal to liquid, as in the preparation of breakfast food, from one fourth to one third as much cereal to liquid is used, depending upon the consistency desired. The usual amount of salt should be added. The gruel may be made with whole milk, skim milk, water, whey (the lactalbumin in whey is digested with greater ease, see Milk), or with diluted or undiluted evaporated milk, depending on the food value desired. Or the gruel may be merely breakfast cereal diluted to the correct consistency with any chosen liquid. Smoothness, temperature, consistency, and seasoning are of paramount importance. The difference between cold, lumpy, unseasoned gruel and hot smooth well seasoned gruel is striking. Straining is essential for smoothness. Gruel may also be made by soaking any of the "cold" cereals or crackers in the proper

amount of hot liquid. Gruels may be enriched with cream or butter, egg yolk or whole egg or grated cheese. Combinations of cereals lend variety.

Cream soups are gruels to which vegetables have been added. They may be prepared by using a flour or cornstarch gruel as a base in order to avoid distinctive cereal flavor. Such gruels are known as white or cream soups. Any cooked vegetable which has been puréed may be added. Vegetables served to the family may be added to a white sauce to form a cream soup for an invalid's tray. Strained vegetables prepared for infant feeding may be used in this way. The caloric and nutritive values of cream soups may be adjusted by the type of milk used or by padding with cream or butter. Mixtures of vegetables form delicious flavor combinations. Clear vegetable juice especially with a few drops of lemon is usually well liked. Powdered de-bittered yeast may be added if desired thus increasing the nutritive value.

Fruit may be given as fruit juice and is refreshing enough to be well tolerated by most individuals. It may be padded with lactose, egg or banana rubbed through a fine strainer and beaten into the juice. Lactose in large amounts has a temporary laxative action but one tablespoonful to a glass of fruit juice is well tolerated. Beta lactose is five times more soluble than the alpha form. Gelatin may be dissolved in any fruit juice and thereby increase its protein value. Such a drink must be served immediately to prevent thickening of the juice before ingestion.

Carbonated drinks are refreshing and when cream, ice cream or powdered milk is whipped in they have definite food value. Tea and coffee may be allowed in moderation except in rare instances.

Thus any caloric fat protein carbohydrate ketogenic and ketogenic level or acid base balance may be obtained in palatable attractive liquid diet which may be maintained indefinitely. In making adjustments as to protein fat and carbohydrate levels or in padding it must be remembered that diarrhea may result from high lactose or large amounts of fat and that fermentation with gas and possible distention may result from excessive use of any sugar.

Because of the increasing recognition of the value of a diet higher in protein than normal in many clinical conditions such

## BASIC DIET MODIFIED

FOODS	REGULAR		100 GM PROTEIN		LIGHT	
	AMOUNT	MODIFICATION	AMOUNT	MODIFICATION	AMOUNT	MODIFICATION
Milk—whole	2 cups	---	5 cups	---	2 cups	---
Egg	1	---	2	---	1	Not fried
Meat, poultry, fish, cheese	4 oz EP	---	7 oz EP	---	4 oz EP	Tender meats, fried
Bread, cereal, whole grain—enriched	4 servings	---	4 servings	---	4 servings	-
Potato—cooked	1 small	---	1 small	---	1 small	Not fried
Vegetable—green leafy, yellow	1 portion	---	1 portion	---	1 portion	Cooked, tender, lettuce only vegetable
Vegetable—other	2 portions	---	2 portions	---	2 portions	Tomato raw, cooked or pur vegetables
Fruit—citrus	4 fl oz or 1 av portion	---	4 fl oz or 1 av portion	---	4 fl oz or 1 av portion	Only grapefruit, orange, or fruit juice
Fruit—other	2 average portions	---	2 average portions	---	2 average portions	Canned, cooked without skins banana
Butter, fortified margarine, oils	3 tbsp	---	3 tbsp	---	3 tbsp	-
Soups	Any	---	Any	---	Any	Clear or cream soup, not sp
Sweets*	Any	---	Any	---	Any	Omit jam, marmalade, or candy with fruit, no pastries
Dessert	2 servings	---	2 servings	---	2 servings	Omit doughnuts, pastries
Miscellaneous†	Any	---	Any	---	Any	Omit relishes, spices

EP—Edible portion

\*Candy jam jelly sugar honey, syrups molasses

†Gravy spices relishes herbs nuts carbonated beverage

as surgery, some chronic illness, and subnutritional states, many hospitals are including a "high protein diet" as part of the standard diet regimen. The extent to which protein is added to the normal diet varies with the institution. In some cases a 100 gm protein diet is considered "high," while in others 250 gm of protein is a "high protein diet." This affords an illustration of the importance of proper nomenclature. Using the standard

# CENTRAL SUGGESTIONS FOR DIET THERAPY

15

## STANDARD HOUSE DIET

SOFT		FULL LIQUID		CLEAR LIQUID	
AMOUNT	MODIFICATION	AMOUNT	MODIFICATION	AMOUNT	MODIFICATION
1 cup	Not fried	3 cups 1 or 2	1 quart powdered milk in leverage or in thin custard		
4 oz EP	Tender meats purée meats not fried	2 or more	Homogenized only		
4 servings	Refined only	4 servings	Gruel or strained farina		
1 small	Not fried omit skin	1 or more	Purée in soup		
1 portion	Cooked tender or purée	1 or more	Purée in soup		
2 portions	Cooked tender or purée	1 or more	Purée in soup juices		
4 fl oz	Fruit juice	4 fl oz or more	Fruit juice (strained)	Any	Strained juice
2 average portions	Canned cooked without skins purée banana	2 or more portions	Fruit juice (strained)	Any	Strained
3 tbsp	Only butter mar garine cream	3 or more tbsp	Only butter mar garine cream		
Any	Clear or cream soup not spiced	Any	Only clear or cream soup	Any	Clear soup (broth less)
Any	Omit jam marmalade or candy with fruit nuts	Any	Only sugar clear candy honey	Any	Only sug candy
2 servings	On it doughnuts pastries cakes other than angel food and sponge	2 or more servings	Plain ice cream gelatin desserts in custards rennet sherbet	2 or more servings	Only plain with
Any	Omit relishes spices nuts popcorn	Any	Salt some spices carbonated leverage	Any	Salt car beverage

of 15 gm of protein per kilogram of body weight the high  
tein diet for the 25 year old reference woman of the Nat  
Research Council would consist of 825 gm Table 75 indi  
how the normal diet could be modified to supply 100 gm of  
tein Above 100 gm intake padding must be resorted  
Such padding can be both at mealtime and as the between  
drinks (See previous discussion)

A review of Chapters 5 and 6 will demonstrate that pro  
metabolism cannot be halted On a diet completely devoid

protein, nitrogen continues to appear in the urine, indicating utilization of body protein. On experimental diets containing no protein, the protein equivalent of the urinary nitrogen ( $N \times 6.25$ , since protein is approximately 16% nitrogen) indicates that the protein breakdown amounts to 3 or 4% of the total caloric production. In the adult man, this is not far from 25 gm protein daily. It is evident, then, that protein deficiency can increase rapidly in the face of increased need and inadequate supply.

A number of high protein products, in addition to those previously mentioned, suitable for oral use have come onto the market. Gerilac, Meritene and Dietene Accessory Feeding, etc. Excellent suggestions for use accompany some products. Countless other protein products are available which serve admirably for tube feeding, but flavor in many instances makes their normal oral administration difficult. We have Aminoids, Nutrigest, Protolysate, Essenamine, Somagen, Lactamin, Delcos Granules P H V, Protinal, and many others. These are digests of various proteins, either one or of a combination (liver, yeast, casein, lactalbumin, wheat). They may be hydrolyzed (such products are known as hydrolysates) either by acid or enzymes. They may or may not have carbohydrate, minerals, and vitamins added. Careful reading of the label is essential. They range in protein content from 15 to 75%—and in price up to \$5.00 per pound. Comparison of the label data with the composition of powdered skim milk at 25 to 30 cents a pound gives added emphasis to the value of powdered skim milk for oral use.

Table 75 summarizes the discussion of the general or house diets. That the normal diet can be modified in physical consistency to the 100 gm protein diet, the light diet, the soft low fiber diet, and to the full liquid diet and still retain its nutritional adequacy is demonstrated. This table assumes that there is no indication that the basic diet needs to be modified in terms of flavor or amounts of specific nutrients.

### Modifications in Techniques of Service

Occasionally a patient is too ill to eat. When this occurs, feeding measures must be employed. He may be fed intravenously by blood transfusions. Under certain conditions especially if there has been blood loss this is ideal at least as a beginning since it immediately provides all the essential nutrients, formed

elements and antibodies of the blood. Transfusions are used frequently today and are of great value. No longer are they considered as a last resort.

Another method of feeding is by slowly injecting fluids subcutaneously or intramuscularly (clysis or hypodermoclysis). This is useful in supplying large amounts of liquid to patients who might otherwise become seriously dehydrated. Physiological salt solution (0.7% approximately 1 teaspoonful to a pint of water) or glucose (2 to 5%) may be given in large amounts.

Glucose in various concentrations of physiological salt solution can also be given directly into the vein (intravenously). By a slow continuous drip method it is possible to administer large quantities of fluid salt and glucose. As high as 5 to 6 liters may be given in twenty four hours. Since the percentage of glucose may be high several thousand carbohydrate calories may be supplied and may be lifesaving in starvation from acute illness. Fluids should not be forced beyond 8 to 10% of body weight in twenty four hours. Above this amount water intoxication will result with chills, nausea, vomiting, sweating, dizziness and even disorientation and convulsions.

When glucose is administered members of the B complex incorporated in the solution facilitate its utilization and is considered the logical procedure. The addition of ascorbic acid may be worth while.

Protein can be administered satisfactorily either as a mixture of pure amino acids or as a protein digest. A 5% amino acid or glucose solution is well tolerated. Fats\* also have been successfully administered by intravenous injection with the protein and glucose. (See discussion of Parenteral Feeding.)

The tube feeding is another form of the liquid diet. By this method food in liquid form is introduced directly into the stomach through a tube from the mouth, nose or an artificial opening in the gastrointestinal tract. The food can be given

\*Clark and Brunswig report the daily use of a highly concentrated 17 day period (Proc Soc Exper Biol & Med 49: 39, 1941). A cubic centimeter finest egg lecithin and added through homogenizer 10% dextrose 500 cc emulsion were combined at the rate of 500 cc.

More recently other investigators have been experimenting and finding it may prove a feasible addition where high caloric intake is indicated (Nutr Rev 1: 1, 1941).

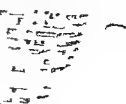


TABLE 76  
CALCULATION OF A POSSIBLE TUBE FEEDING

FOODS	AMOUNT	FOODSTUFFS				MINERALS			VITAMINS						
		CAL ORIES	PRO TEIN GM	FAT GM	CARBO HYDRATE GM	CAL CIUM GM	IRON MG	VITA MIN A I U	THIA MINE MG	RIBO FLAVIN MG	NIA CIN MG	ASCOR BIC ACID MG	VITA MIN D I U		
Milk—whole	5 cups	832	42.7	47.6	59.8	1.440	0.90	—	0.440	2.10	1.4	16	—		
Nonfat dry milk solids	½ cup	217	21.3	0.6	31.2	0.780	0.35	—	0.210	1.17	0.7	4	—		
Eggs—raw	2	154	12.2	11.0	0.6	0.052	2.60	1,100	0.100	0.28	—	—	—		
Purified raw beef liver	100 grams	136	19.7	3.2	6.0	0.007	6.60	43,900	0.260	3.33	13.7	31	45		
Gruel—strained oat meal (baby)	1 oz	111	4.6	2.2	18.2	0.141	0.15	—	0.570	0.14	1.4	—	—		
Purified peas	13 Tbsp	49	4.1	0.3	7.9	0.016	0.14	630	0.090	0.08	1.1	8	—		
Orango juice	100 gm	108	2.0	0.5	27.1	0.047	0.50	—	0.19	0.06	0.6	122	—		
Cream—20%	8 oz	1,078	14.0	96.0	19.2	0.466	0.20	3,960	0.14	0.68	0.4	6	—		
Sugar	2 cups	192	—	—	49.0	—	—	—	—	—	—	—	—		
Molasses	¼ cup	413	—	—	106.0	0.270	7.1	—	0.230	0.210	0.8	—	—		
Total	½ cup	3,290	120.6	161.4	325.0	3.219	18.54	49,590	2.230	8.050	20.1	187	45		

\*Dry weight before cooking

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will pass easily through the tube may be used. As shown in Table 76 a tube feeding may be nutritionally adequate and may be easily modified to meet the specific demands of the illness of the patient. It is a valuable method in feeding patients who are unable or unwilling to swallow.

A less effective method but one which may be resorted to is the nutrient enema. A 5 to 10% glucose is ordinarily used but little dependence can be placed upon the absorption of the sugar. Water however is absorbed.

The crystalline vitamins may be given intravenously or intramuscularly alone or in any solution, when deficiencies require immediate correction.

Except when an obstruction or throat or mouth injuries necessitate prolonged feeding the above mentioned types of feeding rarely are continued for long periods. Much more acceptable are the types of feeding discussed previously the range of standard hospital diets.

Keeping in mind that the goal of food service is either to maintain or to bring about good nutritional status of the individual the importance of an attractive and palatable tray is manifest. Anorexia usually accompanies illness. Appetite must often be tempted by small amounts of food served with utmost care. Colorful trays of attractive china and variations in color and texture of food will many times influence a patient to try to eat. Then the taste teasing quality of the food itself may tempt him to continue. Too much stress cannot be put on attractiveness of food and service. Nutrition must become an art as well as a science.

### Review Questions

1. What is the present day concept of diet therapy as opposed to the older approach?
2. In what ways may the diet be modified in diet therapy? Give examples of each.
3. What are the suggested characteristics of good dietary nomenclature? Give examples of each.
4. What are the factors that may determine the nutritional requirements of the hospital patient?
5. How may the recommended dietary allowances of the National Research Council for the normal individual be used in diet therapy?
6. What are the standard hospital or house diets? How do they differ from the normal diet? Illustrate.



- 7 Which one of these diets (the standard or house diets) may be nutritionally adequate?
- 8 When a person is too ill to take nourishment by mouth, what means of feeding are available? How adequate are these methods? Illustrate
- 9 What factors should be stressed in the serving of any diet?

### Suggested Projects

- 1 Examine your own menu. On the basis of methods of evaluation presented elsewhere, suggest the need of modification of your diet in relation to diet therapy.
- 2 From your own menu pattern, modify your diet in terms of physical consistency for each of the standard "house" diets discussed in this chapter.
- 3 Plan a clear liquid diet for one day. Calculate the nutrients it contains. Evaluate your results with the nutritional needs of the normal individual.
- 4 Calculate a tube feeding using foods other than those in Table 76. Can this be nutritionally adequate?

## CHAPTER 28

### THE DIET OF SURGICAL PATIENTS

Surgical procedures make heavy nutritional demands on the patient. It is advisable to correct malnutrition in depleted patients and to maintain a good nutritional state in well-nourished individuals prior to surgery. Attention should be given to fluids, minerals, vitamins, glucose, and glycogen. Postoperative routine may vary considerably. Nutritional needs are high and may be met by diets modified in consistency and methods of feeding. In some cases, restriction of certain foodstuffs may be desirable.

In considering the dietary adjustments which should be made in the feeding of the surgical patient, it must be realized that no set rules can be laid down. Obviously, the type of surgery, the possible complicating clinical conditions, such as diabetes, nephritis, and the general state of nutrition are all influencing factors. The operation may be minor, the patient may be in excellent health, and his probable convalescence may be short, or the individual may have suffered from his ailment over a period of weeks or months and may be in a state of extreme undernutrition and other disease conditions may complicate. The diet offered will be adjusted to the conditions present, in general it should be high in protein, carbohydrate, and vitamins.

Certain generalizations may, however, be made. Good nutrition is an asset and every effort should be made to preserve or attain this condition. The administration of an anesthetic is always accompanied by fluid loss and gastrointestinal disturbance, and both the anesthetic and the anticipation of an operation are likely to bring about psychic disturbances in varying degree which may be reflected in digestive disturbances. The degree of reaction may differ widely in various patients, even though their general state of health may appear similar. This variation prohibits exact routine procedure and makes personalization of treatment necessary.

The preoperative treatment in general use today predisposes to more rapid recovery than did the older method. Drastic

ing once depleted the body of water just at the time when maximum storage was desirable. Withholding of food or a "light" diet likewise depleted the carbohydrate stores when they should have been at maximum.

Today, unless there are complicating factors or unless the patient is in poor nutritional state, the preoperative diet need not be restricted except in cellulose content. If the indigestible fiber content of the diet is kept low for the last thirty six hours before operation, the fecal mass will be reduced to a minimum at the time of operation, a condition resulting in the same general effect as the preoperative cathartic.

Preoperatively, the fluid intake and carbohydrate should be as high as can be tolerated comfortably. Carbohydrate has a protective action in combating the toxic effect of anesthesia. It has been suggested recently that adequate protein reserves are very important in postoperative recovery. Food should, if possible, be withheld sufficiently long to assure an empty stomach at the time the anesthetic is administered. The usual procedure is no food after the evening meal for an operation scheduled the following morning. If the operation is to be performed in the afternoon, a fluid breakfast is usually desirable.

Frequently a debilitating sickness has preceded the surgical intervention. This will necessitate careful preoperative preparation of the patient if he is to withstand the shock of operation and to make optimum recovery. The diet should be carefully adjusted in the preparatory period so as to be high in protein, minerals, and vitamins—a palatable, easily digested, concentrated diet, directed toward maximum nutritional response. Anemia may complicate the condition and should receive specific consideration (see discussion of The Anemias). Also, if the patient is obese a reduction in weight may be part of the preoperative treatment. Thus, today the nutritional status of the patient before an operation is considered important for both the surgical procedure and the postoperative recovery.

There seems to be no set routine in the postoperative treatment of patients. In some situations the patient is given a clear fluid diet, then a full fluid, followed by a soft diet, and when the attending physician deems desirable, he is returned to a regular house diet. The length of time the patient remains on each diet

and the range of food allowed vary throughout the country. A description of each of these diets is found in Chapter 27.

Immediately following an operation attention is usually focused on the fluid, carbohydrate, protein and calorie content of the patient's nutritional intake. The practice of hypodermoclysis begun before the patient recovers from the anesthetic has been a great boon from the standpoint of later comfort and also speed of recovery. Should the patient be in a state of under-nutrition, however, supplying both liquid and glucose (supported by B vitamins) by parenteral routes as preoperative measures rather than the postoperative hypodermoclysis has proved more advantageous. The immediate postoperative treatment of the patient may include a combination of an intravenous fluid solution which may contain a varied amount of water, glucose, amino acids, minerals and vitamins, blood transfusions and later in the day a tube feeding. As indicated earlier, seldom is a routine procedure adapted for all patients. Frequently the nutritional status of the patient and the type of surgical procedure influence the postoperative nutritional treatment.

It has been suggested that proper attention to nutrition of the patient may reduce the time of convalescence. Many times the postoperative diets reduced in consistency and changed in form to liquid and soft are lower in nutrients than the Recommended Daily Allowances of the National Research Council for the well person. To date there have been no universally accepted standards of nutritive allowances for the postoperative patient. However, it is generally agreed that the nutritive needs of the postoperative patient are higher than those of the normal individual. Pollack and Halpern in *Therapeutic Nutrition* (National Research Council Bulletin No. 234) suggest that the recommended daily allowances of nutrients for normal healthy people should probably be exceeded by about 100 per cent (except for calories) throughout convalescence with the protein intake especially kept high. Rhoads\* also suggests that a 30 to 60% increase in protein requirement and a 20 to 30% increase in calorie requirement above the needs of the normal individual is in order for a mild operation. For an extensive operation he recommends almost twice that much.

\*Rhoads, Jonathan D. *Dietary Requirements of Acutely Ill Patients*. J. Am. Diet. A. 7: 597-903, 1953.

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If the gastrointestinal tract is involved, the postoperative diet must subscribe to the dysfunction. Gastrointestinal activity is then highly undesirable and rest is imperative. In spite of the wish to reestablish normal dietary routine as quickly as possible it is wiser to sacrifice nutrition by the usual methods in these patients for the sake of the local lesion. It may be necessary to withhold food from twenty four hours to as long as several days. During this period nothing may be given by mouth, however, vitamins, glucose, protein, minerals, fat, and fluids may be administered by hypodermoclysis or by the intravenous route (see Chapter 27). The time that elapses between operation and ingestion of food depends on the site and severity of the lesion. An operation for removal of appendix or gall bladder may require abstinence from food for only eight to twenty four hours whereas operations on the stomach, intestine or colon may require much longer abstinence. Diet is resumed with strained fruit juices, ginger ale, broths etc. followed by full fluid soft and

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## CHAPTER 29

### FEVERS, BURNS, AND FRACTURES

When the febrile condition is acute the most important nutritional consideration is the correction of fluid and electrolyte balance along with as high protein and caloric intake as the patient can tolerate. A chronic febrile condition requires specific individualized treatment. In acute phases, the consistency of food may be modified to either a liquid or semiliquid diet. Both fractures and burns may demand an increased amount of protein and calories. The condition of the patient may present difficulties in feeding.

While not directly related, febrile conditions, extensive burns, and fractures make great nutritional demands upon the patient. The degree of these needs will vary with the specific condition. The way in which these high nutritional requirements are met also varies with each patient. However, it is possible to set forth some broad generalizations which may serve as a guide for the dietary treatment of these various conditions.

#### Febrile Diseases

There are three primary factors that govern the nutritional requirements for a patient suffering from a febrile disease: (1) an increase in metabolism, (2) an increased protein metabolism (usually a catabolic loss), and (3) a change in water balance. These factors are considered in detail in the following discussion.

Fever is caused by imbalance between heat production and heat elimination. For every degree Centigrade increase in body temperature above normal, there is a 13% increase in metabolic rate. Thus, a temperature elevation of 37° to 40° C will result in an increased caloric need of about 40%. But other factors may be operative. DuBois suggests that the requirement may be calculated by determining the normal metabolic rate according to age and sex, adding 13% for every degree of fever and 10% more if there is toxic destruction of body tissue, and then adding from 10 to 30% for the restlessness of the patient. Thus, the increased need of a bed patient with fever may be as high as

60% above basal. As has been said repeatedly, good nutrition is the goal in all conditions and it is essential in combating any disease. Therefore the need for approximate caloric balance is apparent. Thus the caloric allowance can be within the range of 3 000 calories.

Protein metabolism is increased in fevers depending upon the grade of infection more than upon the hyperthermia (fever) and its resulting metabolic increase. The breakdown of body protein due to the activity of toxic agents is spoken of as toxic destruction of protein. The extent of the breakdown depends on the causative agent and the grade of infection. (See discussion of high protein diets.)

The protein intake should be sufficiently high to enable the patient to maintain nitrogen balance a condition signifying that body tissues are not being depleted. Pollack and Halpern (*Therapeutic Nutrition*, NRC Publication No. 234) suggest that the allowance of 1 gram of protein per kilogram of body weight should be doubled in febrile disease of more than transient nature. Others have expressed the doubt that all febrile patients can remain in nitrogen balance even though the protein intake is increased far above normal requirements.

A diet sufficiently high in calories and in carbohydrates contributes toward the prevention of protein being used as fuel. Carbohydrate more effectively spares protein than does fat. It combats acidosis and is well tolerated. Moreover carbohydrate stores (glycogen) are quickly exhausted. The glucose of the blood is dependent upon the glycogen and is the most readily available source of energy. Quantities of carbohydrate are therefore required to maintain the glycogen and blood glucose. Wohl\* suggests that the diet should contain carbohydrate equal to one fourth or one half the daily caloric need or from 220 to 420 grams.

The fat level should be essentially normal in amount unless the caloric level is such that carbohydrate alone cannot supply the additional calories. Egg yolk, cream and milk with some butter are the preferred sources of fat.

Because of excessive sweating and increased urinary excretion due to nitrogenous waste fever brings about a greater need

\*Wohl, Michael G. Dietotherapy in Clinical Nutrition, edited by Jolliffe, Tisdale and Cannon.

for water. It has been suggested that the patient drink from 3,000 to 3,500 cc of fluid per day.

The salt intake ( $\text{NaCl}$ ) is important inasmuch as more than normal amounts will be lost in perspiration. Liquid diets will be low in sodium chloride unless care is taken to include salt containing foods, such as broths and soups. It may be wise to add salt to all foods where it will not cause lack of palatability.

The increase in metabolism brings about an increased need for vitamins. Liquid and soft diets, which are frequently prescribed in febrile conditions, may be inadequate in the necessary vitamins. The B complex and vitamin C are those that are especially needed. It has been recommended that vitamin supplements be given in order to meet the increased requirements for these nutrients.

The physical consistency of the diet, that is, liquid, soft, light or regular diet, depends upon the condition of the individual patient. Regardless of the form of the diet, the nutritional requirements remain the same.

In acute febrile illness, that is, when the condition is of short duration (approximately under one week), the primary considerations are to maintain an adequate fluid intake and to offer the food which is most satisfactory to the patient. If possible, he should be encouraged to include fruit juices in the diet so that the carbohydrate may be available as a protein sparer. However, in order to reduce the length of convalescence, to prevent malnutrition, and to forestall vitamin deficiencies, even in acute infections it seems advisable to provide a diet high in nutritional value. Lack of appetite may hinder the ingestion of a desirable diet by normal means, even though the diet may be given in a liquid or semiliquid form. Thus, a tube feeding may be necessary. If the patient has been in an excellent nutritional state, his body stores may be able to meet the stress of a few days of acute infection. Today we no longer "starve a fever," as it may lead to more severe illness, nutritional deficiencies, and an extended convalescence.

Chronic febrile conditions, ones that last approximately more than seven days, have high caloric and protein needs. The number of calories required will depend upon the extent of fever. Pollack and Halpern suggest that in the absence of fever approximately 2,500 to 3,000 calories are desirable. They further

## FEVERS, RICKS AND FRACTURES

suggest about 150 gm of protein daily to prevent protein depletion and to provide for growth and regeneration of diseased tissues. In addition vitamin supplements are usually given. The diet usually progresses from liquid to soft low fiber foods depending upon the condition of the patient.

Typhoid fever is a general infectious disease with specific manifestations in the intestines the early appearance of Peyer's patches with subsequent necrosis and ulceration. The most striking gross lesions appear in the small intestine. Liver and gall bladder changes follow.

Our knowledge of the importance of diet in fevers has been broadened by the work on typhoid fever carried out at the Russell Sage Institute. Experiments there indicated that a 23 to 44% metabolic increase exists in typhoid fever. The older type of diets which supplied from 300 to 500 calories daily on the premise starve a fever resulted in such emaciation that convalescence was much hampered. The diets proposed by Shaffer and Coleman in 1908 and 1909 completely revolutionized the treatment of typhoid. Their diets were calculated to contain 3000 to 5000 calories daily. Protein destruction in this disease is about three times the wear and tear quota of health and increase in protein intake must be provided to meet it. Roughly 15 to 2 gm per kilogram will accomplish this if there is also an increase in calories and carbohydrate. Twice the normal calorie requirement will be adequate or 60 to 80 calories per kilogram according to Coleman.

Coleman found that the duration of the disease was shortened the diarrhea lessened weight loss prevented and hemorrhage and perforation less frequent mortality decreased and convalescence shortened by the use of a liberal adequate dietary regime. Hemorrhage or perforation however of necessity demands immediate discontinuance of food. The diet is necessarily liquid at first then semisolid until convalescence is complete. It must be devoid of indigestible cellulose. The usual feeding schedule in this disease is to administer food at two hour intervals from morning until mid evening usually eight feedings of roughly 400 to 500 calories each. As the patient improves the meals are adjusted to three main meals with three in between meals as used frequently in diet therapy. The foregoing general suggestions for diets in febrile diseases also apply to typhoid fever.



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Chronic febrile conditions are ones that last approximately more than seven days, have high caloric and protein needs. The number of calories required will depend upon the extent of fever. Pollack and Halpern suggest that in the absence of fever, approximately 2,500 to 3,000 calories are desirable. They further

progress to a soft or a light diet. The food should be simple easily digested and well prepared. Inasmuch as tuberculosis is a disease of long duration and curtailed activity the diet must be adjusted to the patient's economic, environmental and personal characteristics. Contentment is of prime importance. Lack of appetite is frequently a difficult complication.

Pneumonia is an acute infection in which there is disturbance of chloride and nitrogen metabolism with lung involvement. Metabolism may be increased as high as from 20 to 50% above normal. Because the disease is of short duration the procedure suggested in the discussion of acute febrile diseases is applicable in pneumonia. The diet should be a palatable liquid diet given in small amounts at short intervals necessitating minimum exertion and disturbance. Fifteen hundred to 2000 calories will normally be sufficient. Fruit juices supply vitamin C which is thought by some to have more than usual value in promoting resistance to the infection. The necessity for lung rest and factors which affect respiratory exchange apply also to pneumonia.

The distressing abdominal distention which sometimes occurs in pneumonia is not of dietary origin but probably is due to toxic paralysis of the intestine. Increased salt intake is found by some to decrease the symptom. During convalescence the diet is gradually changed from liquid to soft and then to the regular diet (as described in Chapter 27).

In brucellosis (undulant fever) (the mortality rate is from 2 to 5%) the patient suffers from a generalized aching headache, anorexia, chilliness, insomnia, backache and stiffness or pain in the joint. The temperature may rise to between 104° and 105° F. *As symptoms subside an extreme weakness occurs.* The temperature increases in the afternoon and evening followed by drenching sweats. The febrile phase lasts three days to six weeks which may recur after a few days of normal temperature. The diet in this condition follows the general procedure set forth previously. However it is modified according to the preference and the condition of the patient.

In scarlet fever there is disturbance in the elimination of nitrogen and retention of sodium chloride according to DuBois. Therefore milk and fruit juices are suggested as suitable low

Tuberculosis is a chronic long continued disease with little or no metabolic increase, according to McCann and Barr, except where temperature elevation occurs. Protein destruction is less intense than in other fevers, and since dynamic action is the same as in normal persons, the protein level should be the same as maintained in health if metabolic increase from dynamic action is to be prevented. Another factor to be kept in mind in tuberculosis is that protein and carbohydrate affect the volume of respiration to a greater extent than does fat. Since lung rest is imperative in pulmonary tuberculosis, modern dietary treatment consists of a moderate protein and carbohydrate level and a high fat intake, a regime much more to be preferred than the old milk egg lactose drinks with which the patients were formerly stuffed.

It has been reported that the tuberculous patient may suffer from a protein deficiency, a vitamin A deficiency, and an ascorbic acid deficiency. These, of course, will be taken into consideration in the diet prescription.

Although correction of malnutrition is indicated, it is recognized today that obesity is not an asset in the tuberculous patient and rapid weight gain does not necessarily indicate clinical improvement.

There is variation in the recommendations for protein in the diet for tuberculosis. McCann suggests that a diet containing 60 to 90 gm of protein 150 gm of fat, and enough carbohydrate (about 200 gm) to bring the caloric intake to 2,500 calories is sufficient for the average patient on bed rest. McLester and Darby propose a liberal though not excessive amount of protein from 15 to 175 gm per kilogram of body weight, or from 100 to 125 gm daily for the average patient. Getz reported that patients at bed rest, with no out of bed privileges were offered 120 gm of protein or more per day. The food left on the tray was weighed and it was found that these patients consumed 90 gm per day. Getz further recommended that the increased need for ascorbic acid and vitamin A be treated as a medical problem, that is, even though foods rich in these vitamins are included in the diet, it is difficult to provide the necessary amounts without additional supplementation.

The diet itself may follow the pattern common to all febrile conditions liquid or semiliquid in the acute stage and then

One of the most major considerations in the treatment of burns is the amount of protein lost by the patient. This may take place in three ways: (1) the catabolic phase in which nonprotein nitrogen is found in the urine, due to metabolic disturbance, (2) there may be from 10 to 50 gm. of protein lost daily in the protein rich exudate of the injured area, and (3) from plasma protein which has infused the injured tissue. Again, the extent of the protein loss depends upon the severity of the burns.

Other nutritional losses which are equally serious are those of fluid, electrolyte, and vitamin. Anemia is frequently an additional problem. Fluids are lost through the exudate as well as some electrolytes, primarily sodium chloride. Even though the body may be dehydrated, edema might also occur. There is a decrease in blood volume and a disturbed electrolyte balance. It has been observed that large amounts of ascorbic acid may be given to the patient without additional excretion of this vitamin. Evidence indicates that the patient may also require increased amounts of thiamine, riboflavin, and nicotinamide after severe burns.

The treatment of burns is initially a medical one (especially if the patient is gravely injured) directed toward saving life, that is, the treatment of shock and prevention of infection. However, along with these measures are the correction of the fluid and the electrolyte balance by blood plasma, and other means. These procedures are of course beyond the scope of the current volume.

The principles of the dietary treatment are to replace the losses incurred, to reconstruct tissue and to maintain a state of good nutrition. Large amounts of protein are needed. It has been suggested that as much as 300 gm. per day might be required. In order to obtain maximum benefit from the ingested protein the calorie content of the diet should be adequate. Pollack and Halpern have estimated that as much as 3,500 to 5,000 calories may be indicated. If the patient is gravely ill, it may be impossible for him to ingest such large amounts of food by usual means. It may be necessary to encourage him to drink, if that is feasible, special liquid drinks high in both protein and calories. These may include protein concentrates and fat emulsions. If the patient is unable to ingest any food by mouth, perhaps a tube feeding may provide the necessary nutrients. It

## MODIFICATIONS OF NORMAL DIET

protein foods in the acute stage, after which the usual plan of liquid diet, then soft diet, and on to the house diet and normal protein intake is instituted.

**Rheumatic fever** frequently occurs in patients who have been living on diets below accepted intake. It is important therefore to check this point and immediately correct the deficiencies. The deficiencies are listed as protein, vitamins A and D, calcium, phosphorus, and iron. High dosage of vitamin C has been advantageous according to some reports. Anorexia is a disturbing complication. The general rules for febrile conditions apply here. Should ACTH be given, sodium will need to be restricted.

**Poliomyelitis**, while not requiring dietary adjustments to the extent in other diseases, may need equally careful dietary planning. The condition has a period of acute fever followed by a long convalescence. Due to paralysis, swallowing may be difficult. Coordination may be impaired. Because of widespread cellular destruction, potassium is lost. Anorexia is a problem. Skill at its best must be used to overcome this and restore the patient to an intake of food suitable for growth and repair.

**Whooping cough** is frequently rather long drawn out, and malnutrition often becomes an unwanted complication. Loss of food in vomiting may be serious. Smaller, more frequent, and more concentrated meals of easily digested foods may prove helpful. Deficiencies must be guarded against. If food ingestion cannot be made adequate, commercial vitamin products and various means of padding may be employed.

In other febrile conditions the affected part and the patient's comfort serve as guides to necessary adjustments in the diet. Nursing care and special attention in the care of the mouth, which should be cleaned before and after feedings, will go far in encouraging the patient to eat adequately.

**Burns**

Diet therapy is important in the treatment of burns. The role nutrition plays is, of course, in proportion to the severity of the injury. In many cases, feeding the patient by normal methods presents a difficult problem and other means, such as tube feedings and intravenous solutions, are necessarily employed.

lem of patients with fracture of the jaw is the length of time devoted to eating. A patient is easily discouraged, because of these many problems, from eating an adequate amount of food.

### Review Questions

- 1 What dietary adjustments are necessary in acute febrile conditions?
- 2 What causes hyperthermia?
- 3 To what extent does fever affect the metabolic rate?
- 4 Is the old saying "Stuff a cold and starve a fever" now tenable?
- 5 What attention should be paid to protein in the diet of a fever patient?
- 6 How and why is the carbohydrate in the diet affected?
- 7 How is the fat level affected? The water? Sodium chloride?
- 8 What specific dietary measures are required in typhoid fever?
- 9 How does the diet for tuberculosis differ from the normal diet?
- 10 What type of diet is advised in the acute stage of pneumonia? Scarlet fever?
- 11 What complications may ensue in whooping cough which affect the dietary regime?
- 12 How may the normal diet be modified in the treatment of burns? Why?
- 13 How may the normal diet be modified in the treatment of fractures of the long bones?
- 14 What are the complicating factors in the dietary treatment of the patient with a fracture of the jaw?

### Suggested Projects

- 1 Plan a day's menu for a child suffering from a chronic febrile condition. Consider all the factors necessary in feeding children (refer to Chapter 20).
- 2 Plan a day's menu for an adult man with fracture of the jaw. Consider his nutritional needs and the consistency of the diet. How long do you think it would take the patient to eat each meal?
- 3 Plan a day's menu for a girl 25 years old who is a tuberculous patient.

## MODIFICATIONS OF NORMAL DIET

may be found that vitamin supplementation will be needed to supply an adequate amount of vitamins to meet the increased requirements.

As indicated, preventing tissue depletion is essential to normal healing. Throughout convalescence, a high protein, high calorie diet is usually indicated in the treatment of patients with burns

## Fracture

In some instances, patients with fractures do not receive special dietary attention though nutritional measures are often indicated. When a patient suffers a fracture of the long bones, there is evidence that there is an increase in protein catabolism, even in well-nourished individuals. This nitrogen loss in the urine has been observed soon after fracture and, in many cases, nitrogen equilibrium has not been re-established for several weeks. There is also a loss of potassium, phosphorus, and sulfur. A calcium loss occurs especially when the patient is immobilize. This loss cannot be met by giving the patient calcium. There may be a disturbed electrolyte and water balance.

As in other conditions, the nutrition of a patient with fracture is directed toward the replacement of losses plus a liberal supply of protein, calories, and vitamins and minerals. The specific amounts of these nutrients are determined by the condition of the individual patient. Pollack and Halpern suggest that about 150 gm. of protein per day and 3,000 nonprotein calories might be needed. In addition, the fluid and electrolyte balance is corrected. A high protein diet is believed to help with deposition of calcium in the bones. Usually, it is possible to provide the patient with the necessary nutrients in the normal meal pattern with, perhaps, high protein-high calorie in-between feedings. A difficulty arises in the dietary treatment of patients with fracture of the jaw. Usually the patient's jaws are wired so that he may open his lips but not his jaws. It is necessary that the food be of a consistency so that it may be held in the cheek and sucked through the spaces around the wired teeth. The jaw may be wired from approximately three to six weeks. The food, then, must be concentrated in calories and other nutrients and be of a gruellike consistency. To increase "taste appeal," there should be some item at each meal which is "clear," with a sharp, identifying flavor, such as a broth or tea. An additional prob-

and Best who were working in the laboratory of Dr. J. J. R. Macleod in Toronto. They discovered that an extract of the islet cells (or islands of Langerhans) would when injected into a diabetic animal control the diabetes. The Nobel Prize in Medicine for 1921 was the reward for this lifesaving contribution. Dr. John R. Murlin to whom this book is dedicated was one of those contributing greatly to our knowledge of insulin and diabetes.

Since the discovery and the clinical use of insulin diabetes has ceased to be the death dealing disease it was formerly. The diabetic person is no longer an invalid. No longer must he drastically restrict his food, indulge in fast days or curtail his activities. Insulin has given him a more liberal diet both in kind and in amount and he is now able to take his place in the economic world and in the world of pleasure.

Three conditions bear the term diabetes: renal diabetes, diabetes insipidus and diabetes mellitus. Renal diabetes refers to a condition in which there is an abnormal permeability of the kidney to glucose resulting in the lowering of the renal threshold and the consequent appearance of abnormal amounts of glucose in the urine. It is questioned if the incidence of this condition is as great as was formerly believed. Diabetes insipidus is an uncommon chronic condition in which enormous quantities of dilute urine are excreted daily (7 to 20 liters and sometimes more) due to pituitary dysfunction.

Diabetes mellitus has been defined as a chronic disease of metabolism with heritable tendencies in which the body has lost its ability in varying extent to utilize glucose because of inadequate insulin production by the pancreas.

The incidence of diabetes mellitus in the United States (the condition which is commonly called "diabetes") is estimated to be near 2,000,000. It is believed that there are many individuals who are undetected and therefore uncontrolled diabetics. One of the programs in public health is directed toward the detection of these unknown diabetics. Diabetes is found more often in women than in men and is highest between 50 and 64 years of age. However it is often found in children and in young adults. There is a higher incidence among the urban than rural population.



## CHAPTER 30

### DIABETES MELLITUS

Diabetes mellitus is a disorder of carbohydrate metabolism which has progressed from a near fatal condition to a controlled disease in the twentieth century. Dietary management and the administration of insulin are the principal features in controlling diabetes. There are several dietary methods in use today. Insulin shock and diabetic coma are conditions resulting from uncontrolled diabetes. Education of the patient concerning his diet and simple laboratory tests are important in maintaining a "healthy" diabetic.

The disease diabetes mellitus has been known for centuries. The name is derived from the Greek words *diabetes*—to pour through—and *mellitus*—honey. Aetnaeus, the Cappadocian, who lived about the first decade of the Christian Era, described two of the cardinal symptoms, emaciation and excessive urination when he wrote that there was "melting of the flesh which flowed away in the urine." Chinese literature as early as the third century referred to the large volume of urine in diabetes "so sweet that it attracted the dogs" and on through the centuries references to the disease appear, with speculation and suggestion as to its cause and the therapy used. Hot and cold baths, wines, massage in the sun, whey and milk diets were used, as well as various types of medication.

In 1869 Langerhans showed that certain cells in the pancreas had a function other than the production of pancreatic juice. In 1889 Minkowski and von Mehnig proved that the pancreas was concerned somewhat with diabetes, since removal of this organ from the dog resulted in diabetes. In 1901 Opie in America and Ssobolew in Russia proved that dysfunction of the cells which Langerhans had described, and which bear his name, resulted in diabetes, and that it was not a dysfunction of the pancreas as a whole.

Between 1869 and 1921 many brilliant experiments were performed which led finally to the discovery of insulin by Banting

regulating mechanism of the body. This, in turn, may lead to an improvement in the ability to utilize glucose.

It must be recognized that fats and proteins as well as carbohydrates contribute to glucose stores and subsequent carbohydrate metabolism within the body (see Chapter 6). In animals rendered diabetic by removal of the pancreas or by phlorhizin poisoning, it is possible to show that 58% of ingested protein, 10% of fats, and 100% of carbohydrates are converted to glucose. Forty six per cent of the protein and 90% of the fats are converted to fatty acids. Some amino acids may be converted either to glucose or to fatty acids (they are amphoteric). Therefore, the values for the amounts of carbohydrate and fat as ingested are not correct values for the total *glucose or fatty acid available to the body*. To determine these latter values, calculation must be made as follows:

Total available G\* = 100% carbohydrate + 10% fat + 58% protein

Total available FA\*\* = 90% fat + 46% protein

\*G—glucose, \*\*FA—fatty acid

Fat metabolism, as well as that of carbohydrate, is disturbed in diabetes. The concept that "fat burns in the flame of carbohydrate" is no longer accepted. As was indicated in Chapter 6, fatty acids (the end products of the digestion of fats) are carried to the liver and oxidized there to ketone bodies, namely, beta hydroxybutyric acid, acetoacetic acid and acetone. These ketone bodies are then sent to the cells where they are further oxidized for energy. Normally this proceeds in an orderly fashion. However when the utilization of glucose for energy is limited by an insufficient amount of insulin (as in diabetes), the body calls upon its second source of energy, the fatty acids. Up to a certain point fat metabolism is complete and there are no excess ketone bodies. As the mobilization and oxidation of fat is increased to meet this emergency the mechanism for complete oxidation in the cells does not proceed at a rate rapid enough to be able to keep up with the ketone bodies from the liver. Thus, a condition known as ketosis or acidosis occurs. The ketone bodies a result of incomplete fat metabolism, are excreted in the urine (ketonuria). If this condition is not treated, the concentration of ketone bodies in the blood may be so high as to cause coma and ultimately death.

The cause of diabetes is unknown. However, there are several factors which are frequently associated with diabetes. One of the primary factors is heredity. It has been shown that the condition is inherited as a Mendelian recessive characteristic. There is a variation within the prediction of diabetes in the children, in the combinations of marriage of diabetics, and carriers. However, it has been predicted that if a diabetic person marries a nondiabetic person, that is, an individual who is neither a carrier nor a diabetic, none of their children will have diabetes of heritable origin.

A second predisposing factor in diabetes is obesity. Studies have shown that a large percentage of known adult diabetics have been obese. However, a small percentage of the obese develop diabetes. The relationship between obesity and diabetes is unknown, but it is recognized as a predisposing factor.

A third factor which is often mentioned is nervous influences. This finds support in the fact that diabetes occurs more often in mental workers than in manual. Also it is frequently found among those individuals who have ample food and leisure as contrasted to those who must work hard to have an adequate supply of food on the family table.

Although these predisposing factors are recognized, and, in some instances, steps can be taken to prevent the possible development of diabetes, the actual cause of this condition remains unknown.

As indicated previously, metabolism in the diabetic individual is disturbed. The generally accepted concept is that the utilization of carbohydrate is limited because of lack of endogenous insulin. This results in an increased blood sugar, which ultimately reaches the renal threshold level. The unutilized sugar above the renal threshold is excreted in the urine. The renal threshold varies from patient to patient. Apart from a diminished capacity to oxidize glucose in the cell, the body's capacity for storing carbohydrate, that is, the conversion from glucose to adipose tissue, is disturbed. However, the diabetic seems to be able to store some carbohydrate to be released later for use. It has been observed that an increased amount of carbohydrate in the diet may be responsible for an improvement in the sugar-

regulating mechanism of the body. This in turn may lead to an improvement in the ability to utilize glucose.

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Apart from the relationship of protein metabolism to total available glucose and total available fatty acid, it is important that the diabetic patient receive an adequate amount of protein daily. His needs are no different from those of the normal individual.

Thus in diabetes, total metabolism is disturbed. Other organs are involved as well as the pancreas. Those primarily affected are the liver and the adrenal, however, whenever any single gland is disturbed, the fine balance among all glands is affected. A discussion, however, of such disorders, other than a brief review of carbohydrate, fat, and protein metabolism is beyond the scope of the present volume.

Many of the classic symptoms of diabetes arise as a result of the metabolic disorders previously mentioned. *Polyuria*, with its consequent *polydipsia* (extreme thirst), is the body's method of secreting excess glucose. A constant feeling of hunger (*polyphagia*) and a feeling of weakness and lassitude can be the response to the unutilized glucose. The uncontrolled diabetic has been described as a starved person, as part of his food is not available for energy purposes. He often complains of rapid *weight loss*. Many diabetics do not exhibit all of these symptoms, some may have only one or two, and the most common has been the complaint of *general weakness*. It must be remembered that few patients are completely diabetic, most produce some endogenous insulin.

One of the methods frequently used in the recognition of diabetes is the *glucose tolerance test*. Ideally, the patient receives a diet for three days prior to the test which contains a constant amount of carbohydrate, usually 300 gm. The fasting patient is given 100 to 150 gm of dextrose, usually in the form of lemonade as the first meal in the day. An initial blood sugar level, the fasting blood sugar, and one at a 1 hour and a 2 hour interval indicate the degree of utilization of the glucose. Fasting blood normally contains about 100 mg of glucose per 100 cc of blood (It may range from approximately 80 to 120 mg). The normal individual will begin with a level not to exceed 140 mg per 100 cc, at the end of an hour it may be 160 but by the end of two hours it should be nearly back to normal. In impaired carbohydrate utilization the beginning level is higher the peak higher.

and the fall much slower (See Fig 64 for a comparison of various glucose tolerance curves) At a blood level between 150 and 200 mg glucose per 100 cc of blood, the renal threshold is reached, the kidneys can no longer reabsorb the excess sugar, and it spills into the urine. Several factors may influence the glucose tolerance, one, the patient's emotional state. There are other forms of a glucose tolerance test, such as variations in the amount of glucose administered, the way in which the patient ingests carbohydrate, the giving, in some cases, of a calculated and weighed meal consisting of protein fat and carbohydrate, and the intervals at which blood samples are taken. The basic steps in procedure outlined, however, apply to all glucose tolerance tests.

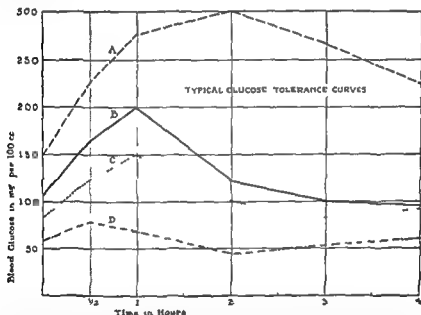


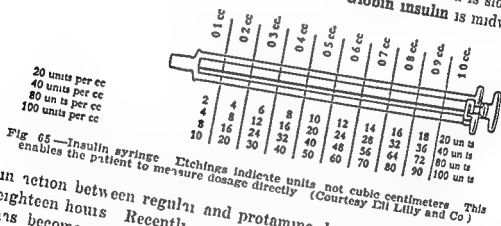
Fig 64—Typical glucose tolerance curves. A Diabetes mellitus. B hyperthyroidism. C normal. D Addison's disease or hypothyroidism or hyperinulinism. (From Andes, J. I., and Eaton, A. C., *Synopsis of Applied Pathological Chemistry*, St. Louis, 1941, The C. V. Mosby Co.)

The present fundamental concept in the treatment of diabetes is to administer enough exogenous insulin which, coupled with the patient's endogenous production, will allow the utilization of available glucose. By correcting the carbohydrate metabolism, protein and fat metabolism can proceed normally. The patient may consume a regulated adequate diet of normal foods. There

## MODIFICATIONS OF NORMAL DIET

is no other effective treatment for diabetes except insulin by injection, although many misleading advertisements to the contrary have appeared.

There are several types of insulin available which will be mentioned briefly as there are variations in the length of time which they remain effective. This, in turn, affects the available carbohydrate distribution in the diet. **Regular insulin** is effective for a few hours. If it is used exclusively, injections are given before each meal and food must follow within half an hour. **Protamine zinc insulin** is more slowly absorbed and exerts its influence over a twenty four hour period. If a patient uses protamine zinc insulin, he must be sure to include an evening, or "night" as it is sometimes called, feeding in his meal plan. **Crystalline insulin** is similar to the regular insulin but is protein free and is slower in its absorption than regular insulin. **Globin insulin** is midway



in action between regular and protamine, lasting approximately eighteen hours. Recently, a **modified protamine insulin NPH 5<sup>n</sup>** has become available. This type is relatively quick in action and has an influence of approximately twenty eight hours. It has been observed by many that a mixture of regular and protamine zinc insulin or the new modified protamine insulin is used in a majority of cases. However, many older diabetics and others who have found the regular insulin satisfactory still use this type. The kind of insulin and the amount is of course a medical prescription.

One unit of insulin will bring about the oxidation of 1 to 3 gm of carbohydrate. A standard unit determined by bio assay, is used to express the strength of insulin. Clinically, it may be obtained in several strengths, 10, 20, 40, 80, and 100 units per

cubic centimeter of solution. The insulin dosage may need adjustment as the result of certain uncontrollable factors. Duncan lists those requiring insulin increase as weight gain, increased food intake, decrease in activity, pregnancy, certain therapies (thyroid, pituitary, deep roentgen ray, dimethylphenol, epinephrine), toxemias, acute infections, fever, ketosis, and ultraviolet ray burn. It must be recognized that increased exercise in the diabetic will decrease the need for exogenous insulin as exercise stimulates the production of the diabetic's own insulin (endogenous).

The diet of the diabetic is based on the nutritional needs of the patient as an individual. The Recommended Daily Allowances of the National Research Council (see Chapter 2) should serve as a guide. If the patient is an elderly adult or if he is an adolescent, his nutritional needs are the same as the normal elderly adult or adolescent. The diet regime of the patient should be individual. It should be flexible enough so that the patient can easily adjust to minor changes in his daily routine. The diet should be adaptable to the patient's cultural food pattern and his economic situation. In short, it should meet all factors that were discussed in detail in Chapter 26.

The total caloric intake needed should be determined by the patient's ideal weight. If overweight, it is recommended by most that the patient reduce. It has been suggested that the adult diabetic is best at approximately 10% below his ideal weight. The recommended amount of protein, usually from 10 to 15 gm. per kilogram for the adult and from 20 to 30 gm. per kilogram for children, should be included each day. The carbohydrate and fat levels of the diet are set by the type of diet that is preferred, that is, either a high carbohydrate diet or a high fat diet. It has been recommended, however, that the ratio of available carbohydrate to available fatty acid be approximately 2 to 1. Thus the carbohydrate and fat prescription would be adjusted to meet the total caloric need of the patient. Translated into percentage of the total calories (see Chapter 24), protein supplies 10 to 20% of the total calories in the diabetic diet, fat from 40 to 50%, and carbohydrate from 30 to 40%. An approximate ratio might be 20:40:40 for protein:fat:carbohydrate calories. *There is no level which is absolute*



The ratio between the three nutrients is one of personal desirability, within reasonable limits, just so long as it can be made clinically effective. Such leeway is possible by the "exchange" method.

The caloric distribution in the normal diet, it will be recalled is 10 to 15% protein, 25 to 40% fat, and 40 to 50% carbohydrate. The food itself should be distributed throughout the day. McLester and Drury suggest that the morning meal should be light and the heavier meal at midday. As mentioned previously a light meal, carrying approximately 20 gm of carbohydrate is needed at bedtime when the patient is taking protamine zinc insulin. This is done in order to prevent an insulin reaction during the night. The diet prescription following the procedure mentioned above as well as guided by the knowledge and experience of the physician is sent to the dietitian, nutritionist or nurse as a specific number of grams of protein, fat and carbohydrate.

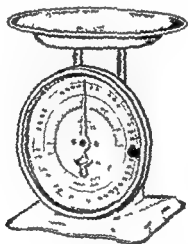


Fig. 66—Scales for weighing food. (Courtesy, Pelouze Manufacturing Co., Chicago.)

The translation of the diet prescription into foods has passed through a variety of stages in the past thirty odd years. At first the individual foods were rigidly calculated and the patients allowed little freedom of choice. The patients were told to weigh all foods (see Fig. 66). Today it is considered desirable to begin the diet with weighed portions if possible in order for the diabetic to become accustomed to accurate portions. Some physicians recommend that the patient always

weigh his food. However, this severely limits the patient's activities, forces him to eat at home always, and has a depressing psychological effect. It was recognized that there are wide variations in the carbohydrate, fat, and protein content of foods, variations due to season, variety, age, and quality of the item. These were discussed in earlier chapters. On the basis of this, many lists of food equivalents were prepared and successfully used. The widely accepted tables of 3, 6, 9, 12, 15, and 18% carbohydrate containing vegetables and the classifications of lean, medium fat, and fat meats are examples of such lists of equivalents. These methods, however, still restricted the patient and required a great deal of unnecessary and often inaccurate calculation on the part of the physician, dietitian, nurse, or nutritionist.

In 1947 a Joint Committee of the American Diabetic Association, the American Dietetic Association, and the Diabetes Section of the United States Public Health Service met as a nationwide effort was made to simplify and standardize a type of dietary treatment. It has long been recognized that there were many current problems relative to the dietary treatment of the diabetic patient. The following problems were listed in a report by the committee\*:

- 1 Wide variability in food composition results in wide differences in figures used in computing.
- 2 Methods used to estimate the composition of a diet may be prolonged and needlessly precise.
- 3 Among clinical workers there are many inconsistencies in the inclusion or restriction of foods.
- 4 Sizes of recommended portions may be stated in impractical amounts which are difficult for the patient to measure.
- 5 Often the instructions to the patient are inadequate in content, particularly where insufficient time is spent in discussing the diet.
- 6 In many instances the diets are not adjusted to the food habits of the individual or so arranged that the patient will know how to plan his diet to fit different situations, such as restaurant meals or packed lunches.

To solve these problems, then, the Joint Committee recognized that its primary purpose was to develop diabetic diet material that would be easy to present to the patient and yet flexible enough that it could be readily adapted to individual food habits.

\*Case, "Calculation of Diabetic Diets," *Am. Dietet. Ass. News*, 575 (1947).

## MODIFICATIONS OF NORMAL DIET

Through the use of this material, it was hoped that many inconsistencies and inaccuracies in diabetic diets would be overcome. Such standardization was believed to be of benefit to professional personnel as well as to the diabetic patient. Late in 1949 the Joint Committee released the material which was incorporated into the booklet *Meal Planning and Exchange List*. Because of the excellence of the material itself and because of the endorsement by these three major professional organizations this plan has enjoyed increasing popularity and acceptability. All foods allowed the diabetic are grouped into six exchange groups. Each exchange group has carbohydrate, fat, and protein value (depending upon the composition of the food within each group). Table 77 contains the composition of food exchanges and the respective carbohydrate, fat, and protein value. Tables 78, 79, 80, 81, 82, and 83 list each exchange individually and the foods included in that exchange. These tables of exchanges are part of the educational material given to the patient. There are many foods that contain little or no carbohydrate, protein, and fat. By allowing an unrestricted amount of these foods the strict value of the diet can be enhanced and the morale of the patient can be improved. Such foods are included in Table 84.

TABLE 77\*\*  
COMPOSITION OF FOOD EXCHANGES

LIST	FOOD	MEASURE	GM	C	P	F	CAL
1	Milk exchanges	1/2 pint	240	12	8	10	170
2A	Vegetable exchanges	As desired	—	—	—	—	—
2B	Vegetable exchanges	1/2 cup	100	7	2	—	36
3	Fruit exchanges	Varies	—	10	—	—	40
4	Bread exchanges	Varies	—	15	2	—	68
5	Meat exchanges	1 oz	30	—	7	5	73
6	Fat exchanges	1 tsp	5	—	—	5	45

TABLE 78\*\*

## LIST 1 MILK EXCHANGES

Carbohydrate—12 gm, Protein—8 gm, Fat—10 gm, Calories—170

	MEASURE	GM
*Milk whole	1 cup	240
*Milk evaporated	1/2 cup	120
*Milk powdered	1/4 cup	35
*Buttermilk	1 cup	240

\*Add 2 fat exchanges if fat free

\*\*Reprinted by permission of Health Publications Raleigh N C

TABLE 79\*\*  
LIST 2 VEGETABLE EXCHANGES

A These vegetables may be used as desired in ordinary amounts Carbohydrates and calories negligible		
Asparagus	"Greens"	Lettuce
Broccoli		Mushrooms
Brussels sprouts	Beet	Okra
Cabbage	Chard	Pepper
Cauliflower	Collard	Raisins
Celery	Dandelion	Rhubarb
Chicory	Kale	Sauerkraut
Cucumbers	Mustard	String beans, young
Escarole	Spinach	Summer squash
Eggplant	Turnip	Tomatoes
B Vegetables 1 serving equals $\frac{1}{2}$ cup equals 100 gm Carbohydrate—7 gm, Protein—2 gm, Calories—36		
Beets	Pars green	Squash, winter
Carrots	Pumpkin	Turnip
Onions	Putabaga	

TABLE 80\*\*  
LIST 3 FRUIT EXCHANGES  
Carbohydrate—10 gm, Calories—40

	MEASURE	GM
Apple	1 small (2 in diam)	80
Applesauce	$\frac{1}{2}$ cup	100
Apricots fresh	2 medium	100
Apricots, dried	4 halves	20
Banana	$\frac{1}{4}$ small	50
Berries straw, rasp, black	1 cup	150
Blueberries	$\frac{1}{3}$ cup	100
Cantaloupe	$\frac{1}{4}$ (6 in diam)	200
Cherries	10 large	75
Dates	2	15
Figs, fresh	2 large	50
Figs, dried	1 small	15
Grapefruit	$\frac{1}{2}$ small	125
Grapefruit juice	$\frac{1}{2}$ cup	100
Grapes	12	75
Grape juice	$\frac{1}{2}$ cup	60
Honeydew melon	$\frac{1}{8}$ (7 in diam)	150
Mango	1 small	70
Orange	1 small	100
Orange juice	$\frac{1}{2}$ cup	100
Papaya	$\frac{1}{4}$ medium	100
Peach	1 medium	100
Pear	1 small	100
Pineapple	$\frac{1}{2}$ cup	80
Pineapple juice	$\frac{1}{3}$ cup	80
Plums	2 medium	100
Prunes, dried	2 medium	25
Raisins	2 Tbsp	15
Tangerine	1 large	100
Watermelon	1 cup	175

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TABLE 81\*\*

## LIST 4 BREAD EXCHANGES

Carbohydrate—15 gm, Protein—2 gm, Calories—68

	MEASURE	GM
Bread	1 slice	25
Biscuit, roll	1 (2 in diam)	35
Muffin	1 (2 in diam)	35
Corn bread	1 (1½ in cube)	35
Flour	2½ Tbsp	20
Cereal, cooked	½ cup	100
Cereal, dry (flake and puffed)	¾ cup	20
Rice, grits, cooked	½ cup	100
Spaghetti, noodles, etc, cooked	½ cup	100
Crackers, graham (2½ in sq)	2	20
Oyster	20 (½ cup)	20
Saltines (2 in sq)	5	20
Soda (2½ in sq)	3	20
Round, thin (1½ in diam)	68	20
Vegetables		
Beans and peas, dried, cooked (Lima, navy, split pea, cow peas, etc)	¼ cup	90
Baked beans, no pork	¼ cup	50
Corn	⅓ cup	80
Parsnips	⅓ cup	125
Potatoes, white, baked, boiled	1 (2 in diam)	100
Potatoes, white, mashed	¾ cup	100
Potatoes, sweet, or jams	¼ cup	50
Sponge cake, plain	1 (1½ in cube)	25
Ice cream (omit 2 fat exchanges)	½ cup	70

TABLE 82\*\*

## LIST 5 MEAT EXCHANGES

Protein—7 gm, Fat—5 gm, Calories—73

	MEASURE	GM
Meat and poultry (med fat) (beef, lamb, pork, liver, chicken, etc)	1 oz	30
Cold cuts (4½ in sq, ½ in thick)	1 slice	45
Frankfurter	1 (8 g/lb)	50
Fish cod, mackerel, etc	1 oz	30
Salmon, tuna, crab	¾ cup	30
Oysters shrimp, clams	5 small	45
Sardines	3 medium	30
Cheese cheddar, American	1 oz	30
Cottage	¼ cup	45
Egg	1	50
Peanut butter*	2 Tbsp	30

\*Limit use or adjust carbohydrate

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TABLE 83\*\*  
LIST 6 FAT EXCHANGES  
Fat—5 gm Calories—45

	MEASURE	gm
Butter or margarine	1 tsp	5
Peanut crisp	1 sh	10
Cream light 20	2 Tl sp	30
Cream heavy 40	1 Tl sp	15
Cream cheese	1 Tl sp	15
French dressing	1 Tl sp	15
Mayonnaise	1 tsp	5
Oil or cooking fat	1 tsp	5
Nuts	1 small	10
Olives	5 small	50
Woollo	1/2 (4 in diam)	50

\*\*Reprint of the publication of Health Publications Institute N C

TABLE 84  
FOODS ALLOWED AS DESIRED  
Negligible Carbohydrate Protein and Fat

Coffee	Rhubarb
Tea	Mustard
Clear broth	Pickle sour
Bouillon	Pickle dill—unsweetened
Gelatin unsweetened	Saccharine
Bennet tablets	Pepper
Cranberries	Spices
Lemon	Vinegar

Specialty or diabetic foods are not recommended. Such foods are costly and unnecessary because they change the "adjusted" food intake to a special diet. The diabetic foods are essentially starch free (gluten bread) or sugar free. Gluten (a protein) must be considered as 50% sugar and therefore can not be eaten at will. Except where saccharine or other artificial sweeteners are desired the diabetic person is wiser to acquire a taste for less sweet foods or drinks.

By using the values listed in Table 77 it is simple to adjust the patient's diet prescription to his usual meal pattern. As pointed out in the committee report nutritive adequacy of the diet will be assured by including the same basic protective foods that are recommended for the normal individual. These include

Milk	1 pint for adults
	1 quart for children
Meat fish poultry eggs and cheese	4 to 5 oz
Whole grain or enriched cereal or bread	To meet caloric need
Fruit—one citrus fruit or tomato	2 servings
Vegetable—on green or yellow	— servings
Butter or fortified margarine	To meet caloric need

The procedure for calculating a diabetic diet is described in the report of the joint committee and reprinted below

*Procedure for Calculating Diabetic Diet\**  
*Sample Prescription*

Carbohydrate	180 gm
Protein	80 gm
Fat	70 gm
Calories	1,700

	Amount	Carbo- hydrate gm	Protein gm	Fat gm
Milk, whole (List 1)	1 pint	24	16	20
Vegetables (List 2, group A)	As desired	—	—	—
Vegetables (List 2, group B)	1 serving	7	2	—
Fruit (List 3)	3 servings	30		
Total carbohydrate from sources other than bread exchanges		61		
180 gm carbohydrate in prescription				
- 61 gm from sources other than bread exchanges				
119 ÷ 15 = 8 bread exchanges				
Bread exchanges (List 4)	8 servings	120	16	
Total protein from sources other than meat exchanges			34	
80 gram protein in prescription				
- 34 gram from sources other than meat exchanges				
46 ÷ 7 = 7 meat exchanges				
Meat exchanges (List 5)	7 servings		49	35
Total fat from sources other than fat exchange				55
70 gm fat in prescription				
- 55 gm from sources other than fat exchanges				
15 gm ÷ 5 = 3 fat exchanges				
Fat exchanges (List 6)	3 servings			15
		181	83	70

To determine the number of servings of bread, meat, and fat exchanges required to complete the diet prescription, it is necessary only to

- Subtract the number of grams of carbohydrate (61 in the example above) furnished by the other sources of carbohydrate from the amount prescribed (180) and divide the result by 15 the number of grams of carbohydrate in one serving of bread exchange as noted in List 4
- The amount of protein in the diet may be adjusted to the prescription by subtracting the number of grams of protein (34 in the example) supplied by milk, vegetables and bread exchanges from the amount prescribed (80) and dividing the remainder by 7, the amount of protein in each meat exchange
- Follow the same procedure with regard to fat, except to divide the result by 5, the number of grams of fat in one serving as noted in List 6

\*Caso Calculation of Diabetic Diets J Am Dietet 1. \*6 579 1950

From a practical standpoint, it is unwise to calculate half exchanges. Such portions become difficult for the patient to obtain. It was recommended that the carbohydrate may vary as much as 7 gm from the amount ordered and the protein may differ by 3 gm. As the fat exchange is 5 gm, it will probably be easy to meet. The division of the exchanges into meals is governed by those factors discussed earlier in the chapter.

The Joint Committee also prepared six simple meal plans which vary in composition. Meal Plan No 3 (Table 85) has been included with two sample menus to illustrate how the food for the day may be divided into a meal pattern, and further, how that meal pattern may be adjusted to various food habits.

From the experience of those who have used the "new" diabetic exchange system enthusiastic endorsement comes from practically everyone. They have found patients receptive as it allows them greater leeway in choice of food and easy adjustment to their surroundings. From the professional standpoint it relieves the nutritionist of time consuming tedious calculations and provides her with more opportunity for patient education.

A step further in liberation of the diabetic diet is the "unrestricted" or "free" diet which has come into use during the last several years. This program has been tried for a dozen years in Europe. The "free" diet permits the patient to eat what and how much he pleases "*within reasonable limits*" with adequate insulin coverage. In order to prevent hypoglycemic shocks there needs to be a fairly continuous glycosuria. This condition the supporters of this regime contend is not harmful. Actually these diets are not wholly unrestricted. The children on whom they have usually been tried have "judicious supervision" of their food habits—first in the hospital and later in the home. However they are permitted leeway in order to satisfy their own individual tastes. Overindulgence is not permitted. Freedom in choice is permitted only after the child has become familiar with the general principles of nutrition and diabetic control through instruction and initial ingestion of a prescribed measured diet. Fairly regular food habits seem to be the rule in the studies so far carried out once the restrictions are lifted.

At intervals during the year, the patient is asked to keep a week's record of his food intake. This is analyzed by the di-



## MODIFICATIONS OF NORMAL DIET

The procedure for calculating a diabetic diet is described in the report of the joint committee and reprinted below

*Procedure for Calculating Diabetic Diet\**  
*Sample Prescription*

Carbohydrate  
 Protein  
 Fat  
 Calories

180 gm  
 80 gm  
 70 gm  
 1,700

Milk, whole (List 1)  
 Vegetables (List 2, group A)  
 Vegetables (List 2, group B)  
 Fruit (List 3)

Amount  
 1 pint  
 As desired  
 1 serving  
 3 servings

Carbo- hydrate gm	Protein gm.	Fat gm
24	16	20
7	2	—
30		
61		

Total carbohydrate from sources  
 other than bread exchanges

180 gm carbohydrate in prescription  
 - 61 gm from sources other than bread exchanges

$119 \div 15 = 8$  bread exchanges

Bread exchanges (List 4)  
 Total protein from sources  
 other than meat exchanges

8 servings

120

16  
 34

80 gram protein in prescription  
 - 34 gram from sources other than meat exchanges

$46 \div 7 = 7$  meat exchanges

Meat exchanges (List 5)  
 Total fat from sources

7 servings

49

30  
 55

other than fat exchange  
 70 gm fat in prescription

- 55 gm from sources other than fat exchanges

$15 \text{ gm } 5 = 3$  fat exchanges

Fat exchanges (List 6)

3 servings

181

83

15  
 70

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- Follow the same procedure with regard to fat, except to divide the result by 5, the number of grams of fat in one serving as noted in List 6

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At intervals during the year, the patient is asked to keep a week's record of his food intake. This is analyzed by the di

## MODIFICATIONS OF NORMAL DIET

TABLE 8.2\*

For

AN DIETETIC MEAL PLAN NO 3

Use only as your doctor prescribes  
 Carbohydrate 180 gm Protein 80 gm  
 Fat 80 gm Calories 1800  
 This meal plan has been prepared to use  
 with the Meal Planning Booklet

YOUR FOOD FOR THE DAY			SAMPLE MENUS		These menus show some of the ways exchange lists can be used to vary the meal plan. The exchange lists and recipes may be found in the Meal Planning Booklet
Amount	Kind of Food	Choose from	Breakfast	Breakfast	
1 pint	Milk		Orange juice $\frac{1}{4}$ cup		
Any amt	Any amt		Egg 1		
1	Vegetable exchanges A	List 1	Toast 2 slices		
3	Fruit exchanges B	List 2 A	Butter 2 tsp		
8	Bread exchanges	List 2 B	Coffee 2 Tbsp evaporated milk †		
7	Meat exchanges	List 3	<i>Lunch or Supper</i>		
5	Fat exchanges	List 4	Ham and cheese sandwich (cheese 1 ounce ham 1 ounce, bread 2 slices, butter 1 tsp)		
		List 5	Lettuce and tomato salad		
		List 6	Zero salad dressing (special recipe)		
Divide this food as follows			Apple 1 small		
			Milk 1 cup (8 ounces)		
			Coffee or tea		
			<i>Dinner</i>		
			Hamburg patties 3 ounces		
			Mashed potato $\frac{1}{2}$ cup		
			Carrots $\frac{1}{4}$ cup (special recipe)		
			Bread 1 slice butter 2 tsp		
			Banana $\frac{1}{4}$ small		
			Coffee or tea		
			<i>Dinner</i>		
			Bologna 2 slices		
			Radishes celery, sour pickles		
			Potato salad (A) $\frac{3}{4}$ cup		
			Bread 1 slice butter 1 tsp		
			Grapefruit $\frac{1}{4}$		
			Milk 1 cup (8 ounces)		
			Coffee or tea		
			<i>Dinner</i>		
			Tomato juice small glass		
			Roast lamb 3 ounces		
			Steamed rice $\frac{1}{4}$ cup		
			Green peas $\frac{1}{4}$ cup		

Lunch or supper	Bedtime	Mixed green salad
2 Meat exchanges from List 5 2 Bread exchanges from List 4 1 Vegetable from List 2A (any amount) 1 Fruit exchange from List 3 1 cup milk from List 1* 1 Fat exchange from List 6 Coffee or tea (any amount)	Milk $\frac{1}{2}$ cup (6 ounces)† Peanut butter sandwich (peanut butter 2 Tbsp., bread 2 slices)	French dressing 1 Tsp Bread 1 slice, butter 1 Tsp Pineapple gelatin (special recipe) Coffee or tea
Dinner or Main Meal	Bedtime	Milk $\frac{1}{2}$ cup (6 ounces)† Graham crackers 4 American cheese 1 ounce
3 Meat exchanges from List 5 2 Bread exchanges from List 4 1 Vegetable from List 2A (any amount) 1 Vegetable exchange from List 2B 1 Fruit exchange from List 3 2 Fat exchanges from List 6 Coffee or tea (any amount)	Bedtime	
1 cup milk from List 1* 2 Bread exchanges from List 4 1 Meat exchange from List 5		

\*Part of milk may be used for coffee, tea, or for cereal.

†2 Tbsp evaporated milk equals  $\frac{1}{2}$  cup whole milk. Part of the milk is taken from bedtime to use at breakfast.

‡Part of the milk is taken from bedtime to use at breakfast.

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etitian and necessary adjustments or advice is given. Urine tests for sugar and acetone are those followed by all diabetics.

An added advantage is the increase in food intake following exercise, which compensates for the lowered blood sugar at such time. This is important for active children.

The major advantage, however, is psychological. Most individuals are happier with a minimum of restriction and rules. There is less worry and nagging on the part of the mother of a diabetic child, less resentment and desire to cheat, with the feeling of guilt which accompanies such action. It is an experiment well worth following. With intelligent patients it would seem to have definite advantages. As one physician put it, patients who broke diet almost constantly, frequently got along "irritatingly" well. Perhaps the strict control which has been practiced is not necessary.

There are those clinicians, however, who strongly object to the use of the "free" diet. Marble pointed out that those patients whose diabetic condition had been best controlled over years of time are those who show the least vascular damage. He felt that present data indicate the importance of meticulously controlled diabetes and that "free" diets are to be discouraged. White suggested that it seemed an advisable practice to have a controlled diet for the entire family instead of a "free" diet for the diabetic member. Others have pointed out that the free plan which allowed a disturbed metabolic state, as hyperglycemia and glucosuria is not desirable. The accepted means of treatment is directed toward maintenance of normal physiological conditions.

After the diet is calculated the insulin dosage is adjusted in amount and distribution to assure normal utilization of carbohydrate as evidenced by a normal blood sugar level, an essentially negative urinary sugar (absence of glycosuria) and the absence of ketone bodies in the urine. The dosage in units will equal approximately one half the number of grams of sugar excreted in the urine when no insulin is given. Obviously careful adjustment must be made in the individual case just as dietary adjustment must be made to personalize the diet itself.

The nutritional needs of the diabetic child are the same as those of a normal child and they should govern his diet prescription. Diabetes in the child is the same as that in the adult but he



**Insulin shock** may occur with great suddenness, and no person suffering from diabetes should ever be without an available source of sugar. If sugar is taken when the first symptoms arise it will frequently avert the shock. The identification card stating that the bearer is diabetic and giving his name, address and the name of the clinic or physician responsible for his care is another wise precaution. It may prevent misinterpretation of his condition.

Hypoglycemia may also result from incorrect distribution of insulin in relation to meals, excessive exercise which reduces blood sugar, or decreased food absorption when a meal is missed or when vomiting or diarrhea occurs.

One might differentiate between these symptoms which occur with regular or crystalline insulin having a time range of four to six hours, those which occur when globulin insulin is used with a range of eight to ten hours, and those of the slower acting protamine zinc insulin with a time range of eighteen to thirty six hours. The symptoms of inadequate blood sugar following the use of protamine zinc insulin ("PZI") tend to come in the early morning hours before breakfast and are more insidious. Headache, weakness, depression, confusion, and sometimes nausea are not uncommon, although at times patients awake with the sharper symptoms of tremor, sweating and hunger.

Hyperglycemia, conversely, is high blood sugar and indicates incomplete carbohydrate combustion with potential ketosis and coma. It results from inadequate dosage of insulin, overindulgence in food, infection which lowers sugar tolerance, or erroneous omission of insulin in any case of illness where diet is restricted under the mistaken idea that only when the full diet is being ingested should the full amount of insulin be taken. It should be well understood that when food is not eaten, body tissues replace the food source of energy, and at least one half of the usual amount of insulin will be needed.

Simple ketosis is evidenced merely by the presence of acetone bodies in the urine and it is readily overcome by proper dietetic supervision.

The early symptoms of a dangerous ketosis are usually of a positive nature consisting of nausea, colic, and abdominal pain.

and especially sudden lack of appetite in a person who previously had a large one. Breathlessness and air hunger are more serious symptoms. Drowsiness is very common.

The unconsciousness of diabetic coma must be differentiated from the unconsciousness of insulin shock, since the treatment of the two conditions is exactly opposite and delay in treatment of either may result in a fatality. Insulin shock comes quickly, coma develops over several hours.

Although the diagnosis of these two conditions can be made from laboratory data, the history and physical examination will give presumptive evidence while waiting for laboratory reports, or even more important, if they cannot be obtained.

TABLE 87

## DIFFERENTIAL DIAGNOSIS OF DIABETIC COMA AND INSULIN SHOCK

DIABETIC COMA	INSULIN SHOCK
<i>Cause</i>	
Increase of diet	Reduction of diet
Omission of insulin	Increase of insulin
Infection	Increase of exercise
	Failure of absorption of food
<i>History</i>	
Gradual loss of consciousness preceded by vomiting	Rapid loss of consciousness sometimes followed by vomiting
No convulsions	Convulsions
<i>Physical Examination</i>	
Skin dry and flushed	Skin moist and pale
Breathing hyperpneic	Breathing shallow
Pulse feeble	Pulse full and pounding
<i>Laboratory Examination</i>	
Blood pressure low	Blood pressure normal or high
Blood sugar high	Blood sugar low
CO <sub>2</sub> under 20 volumes per cent	CO <sub>2</sub> normal or elevated
Diabetic acid	No diabetic acid
Urine sugar	Urine negative or the second specimen negative

TABLE 88

## QUALITATIVE ESTIMATION FOR SUGAR IN THE URINE

Place 5 cc (1 teaspoonful) of Benedict's solution in a test tube and add exactly 11 drops of the urine to be tested. Shake gently and heat over a free flame allowing it to boil one minute. The tube may be heated in vigorously boiling water for five minutes with the same results. Allow the tube to cool spontaneously. The color reactions shown in Fig. 67 indicate the amount of sugar present.



TABLE 89

## GERHARDT'S TEST FOR DIACETIC ACID (ACETOACETIC)

To about 5 cc fresh urine in a test tube add carefully, drop by drop, a 10% ferric chloride solution until no more precipitate forms. A red (Burgundy urine) color indicates the presence of diacetic acid. Diacetic acid is unstable on boiling. Divide specimen into two tubes, boil one and compare to the unboiled sample. If color was due to diacetic acid the color will disappear. If the color was due to a drug, color will remain though change may take place. This is the test commonly used inasmuch as diacetic acid is the easiest one of the ketone bodies to detect.

Repeated urine tests for sugar are of value in differentiating

Laboratory tests are of extreme value in determining the treatment of the diabetic person. With hospitalization, the carbon dioxide level of the blood may be followed as a measure of ketosis change. This is of value during recovery from coma if alkali treatment has not been given. The carbon dioxide level is a differential between coma and shock. Routine tests for the ambulatory and the bed patient consist in measurement of the blood and urinary sugar levels, and of urinary ketone bodies. In the home the daily routine is the determination and recording of urinary sugar by the Benedict test, and at times testing for the presence of diacetic acid, one of the ketone bodies. Diacetic acid (or acetoacetic acid), beta hydroxybutyric acid, and acetone comprise the "ketone bodies."

Color change also expresses the extent to which ketone bodies are excreted in the urine. The appearance of these bodies is a danger signal, a warning of impending coma.

## Review Questions

- 1 To which of the three diabetic conditions is the term "diabetes" commonly applied?
- 2 How is the metabolism of carbohydrate disturbed in diabetes? Of fat? Of protein?
- 3 What are the classic symptoms of diabetes mellitus?
- 4 What calculation must be made to determine the total glucose or fatty acid available to the body from ingested food?
- 5 Why is the fatty acid to glucose (FA/G) ratio important?
- 6 What is the normal amount of glucose in fasting blood? The level found in the diabetic person? The level at which sugar appears in the urine?
- 7 What types of insulin are available? How do they differ in their effect upon the oxidation of glucose?





Fig 1  
Before Boiling



Fig 2  
Negative

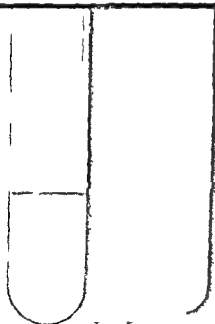


Fig 5  
1 Per Cent Sugar (+++)

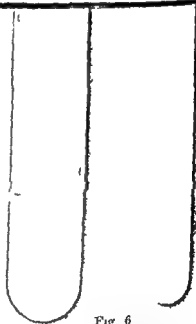


Fig 6  
2 to 10 Per Cent Sugar  
or possibly more

(++)

Fig 67—The qualitative Benedict test

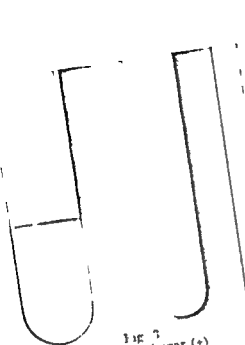


Fig 3  
0.1 Per Cent Sugar (+)

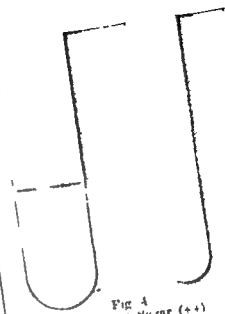


Fig 4  
0.5 Per Cent Sugar (++)

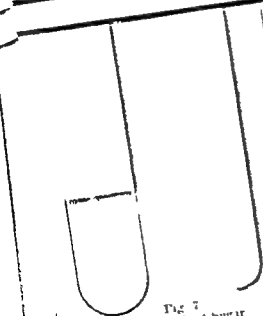
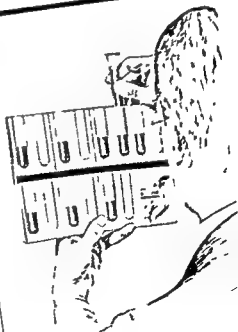


Fig 5  
Over 10 Per Cent Sugar  
(+++)







## CHAPTER 31 SPONTANEOUS HYPOGLYCEMIA

Spontaneous hypoglycemia, in which abnormal carbohydrate metabolism occurs, may be related to many conditions. The dietary management will be governed by the nature of the initial disorder. In some cases a high protein, low carbohydrate diet is recommended, in others a high protein, high carbohydrate regime is indicated. There is no form of dietary management that is successful in all cases of spontaneous hypoglycemia. The diet prescription will be determined by the condition and individual needs of each patient.

Spontaneous hypoglycemia is an indication of disturbed carbohydrate metabolism which may be a result of one of many conditions. It is important to determine the initial condition as the dietary management can vary considerably. Duncan states that "there has been a widespread, and I believe erroneous, tendency to label all cases in which hypoglycemia occurs as being due to hyperinsulinism." Hyperinsulinism is only one of the many conditions which may bring about hypoglycemia in the patient.

In order to give some concept as to the number of disorders that are capable of bringing about the symptom of spontaneous hypoglycemia, the following classification described by Conn\* has been included in Table 90.

There is no one dietary management which is successful in all cases of spontaneous hypoglycemia. A diet modified in one form may prove helpful in some instances whereas it might be contraindicated in another. Conn has found it helpful to classify the different causes of hypoglycemia under two main headings and, on the basis of his experience which has been confirmed by the work of others, has offered two distinct dietary regimens for spontaneous hypoglycemia, depending upon the diagnosis. These two classifications are called *stimulative* and *fasting hypoglycemia*.

It will be remembered that the elevation of blood sugar that arises from the ingestion of food normally is followed by an

\*Conn, J. W. *The Dietary Management of Spontaneous Hypoglycemia*.  
J. Am. Dietet. A. 23: 108, 111, 194.

TABLE 90

## ETIOLOGICAL CLASSIFICATION OF SPONTANEOUS HYPOGLYCEMIA

- 
- I Organic—recognizable anatomical lesion
- A Hyperinsulinism
- 1 Pancreatic island cell adenoma
    - (a) Single
    - (b) Multiple
    - (c) Aberrant
  - 2 Pancreatic island cell carcinoma
    - (a) Localized
    - (b) With metastases
  - 3 Generalized hypertrophy and hyperplasia of the islets of Langerhans
- B Hepatic disease
- 1 Ascending infectious cholangitis
  - 2 Toxic hepatitis
  - 3 Diffuse carcinomatosis
  - 4 Fatty degeneration, "fatty metamorphosis"
  - 5 Glycogenosis (von Gierke's disease)
- C Pituitary hypofunction (anterior lobe)
- 1 Destructive lesions (chromophobe tumors, cysts, etc.)
  - 2 Atrophy and degeneration (Simmonds' disease)
  - 3 Thyroid hypofunction (secondary to pituitary hypofunction)
- D Adrenal hypofunction (cortex)
- 1 Idiopathic cortical atrophy
  - 2 Destructive infectious granulomas
  - 3 Destructive neoplasms
- F Central nervous system lesions (hypothalamus or brain stem, interference with nervous control of blood sugar)
- II Functional—no recognized anatomical lesion, but explainable on basis of unusual somatic function
- A Hyperinsulinism (imbalance of the autonomic nervous system)
- 1 "Hypoglycemic fatigue"
  - 2 "Nervous hypoglycemia"
  - 3 "Functional hypoglycemia"
  - 4 "Reactive hypoglycemia," etc.
- B Alimentary hyperinsulinism (rapid intestinal absorption)
- 1 Postgastroenterostomy
  - 2 Postgastric resection (partial or total)
- C Renal glycosuria (severe degrees of low renal threshold for dextrose)
- D Lactation
- E Severe continuous muscular work
- III Miscellaneous
- A Fictitious or surreptitious insulin administration
  - B Postoperative hypoglycemia
  - C Severe inanition
  - D Unknown
-



## CHAPTER 31

### SPONTANEOUS HYPOGLYCEMIA

Spontaneous hypoglycemia in which abnormal carbohydrate metabolism occurs may be related to many conditions. The dietary management will be governed by the nature of the initial disorder. In some cases a high protein low carbohydrate diet is recommended in others a high protein high carbohydrate regime is indicated. There is no form of dietary management that is successful in all cases of spontaneous hypoglycemia. The diet prescription will be determined by the condition and individual needs of each patient.

Spontaneous hypoglycemia is an indication of disturbed carbohydrate metabolism which may be a result of one of many conditions. It is important to determine the initial condition as the dietary management can vary considerably. Duncan states that "there has been a widespread and I believe erroneous tendency to label all cases in which hypoglycemia occurs as being due to hyperinsulinism." Hyperinsulinism is only one of the many conditions which may bring about hypoglycemia in the patient.

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There is no one dietary management which is successful in all cases of spontaneous hypoglycemia. A diet modified in one form may prove helpful in some instances whereas it might be contraindicated in another. Conn has found it helpful to classify the different causes of hypoglycemia under two main headings and on the basis of his experience which has been confirmed by the work of others has offered two distinct dietary regimens for spontaneous hypoglycemia depending upon the diagnosis. These two classifications are called **stimulative** and **fasting hypoglycemia**.

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    - (a) Localized
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  - 3 Generalized hypertrophy and hyperplasia of the islets of Langerhans
- B Hepatic disease**
- 1 Ascending infectious cholangitis
  - 2 Toxic hepatitis
  - 3 Diffuse carcinomatosis
  - 4 Fatty degeneration, "fatty metamorphosis"
  - 5 Glycogenosis (von Gierke's disease)
- C Pituitary hypofunction (anterior lobe)**
- 1 Destructive lesions (chromophobe tumors, cysts, etc.)
  - 2 Atrophy and degeneration (Simmonds' disease)
  - 3 Thyroid hypofunction (secondary to pituitary hypofunction)
- D Adrenal hypofunction (cortex)**
- 1 Idiopathic cortical atrophy
  - 2 Destructive infectious granulomas
  - 3 Destructive neoplasms
- E Central nervous system lesions (hypothalamus or brain stem, interference with nervous control of blood sugar)**
- II Functional—no recognized anatomical lesion, but explainable on basis of unusual somatic function**
- A Hyperinsulinism (imbalance of the autonomic nervous system)**
- 1 "Hypoglycemic fatigue"
  - 2 "Nervous hypoglycemia"
  - 3 "Functional hypoglycemia"
  - 4 "Reactive hypoglycemia," etc
- B Alimentary hyperinsulinism (rapid intestinal absorption)**
- 1 Postgastroenterostomy
  - 2 Postgastric resection (partial or total)
- C Renal glycosuria (severe degrees of low renal threshold for dextrose)**
- D Lactation**
- E Severe continuous muscular work**
- III Miscellaneous**
- A Factitious or surreptitious insulin administration
  - B Postoperative hypoglycemia
  - C Severe inanition
  - D Unknown
-

increased insulin secretion, which, in turn, brings the blood sugar back within the normal range. The normal individual frequently shows a blood sugar level that is lower than fasting blood sugar about 1½ to 3 hours after taking carbohydrate. Thus, the absorption of glucose automatically stimulates a mechanism which removes this glucose from the blood.

An abnormality which Conn has classified as a stimulative hypoglycemia may occur when this mechanism is excessively sensitive to the normal stimulus or when it is excessively stimulated by an abnormally high absorption of glucose. When either of these reactions takes place a sharp fall of the blood sugar level occurs, which is secondary to the stimulus. Clearly, a high carbohydrate diet will only aggravate a spontaneous hypoglycemia of this origin. It would probably produce frequent and severe attacks.

Functional hyperinsulinism can serve as an excellent example of the first abnormality mentioned above, an excessive sensitivity to absorbed glucose. This condition is believed to be the most common cause of hypoglycemia as it is responsible for approximately 70% of all cases. In functional hyperinsulinism, the fasting blood sugar is always normal. The glucose tolerance test shows a normal elevation of blood sugar following absorption but it then drops quickly to the level of hypoglycemia. Patients suffering from this condition do not experience attacks before breakfast and most occur from two to four hours after meals and usually in the midmorning and midafternoon. It is believed that an ingestion of carbohydrate brought about the secondary hypoglycemia.

At first, in 1931, a low carbohydrate diet was advocated by Waters. But in 1936 Conn recognized the importance of a high protein, low carbohydrate regimen. Carbohydrate is quickly absorbed directly into the blood stream, while protein after being split into component amino acids, is carried to the liver, deaminized, and then 58% is converted to glucose. The release into the blood stream of glucose from protein is a slow and even process. It is so slow that a rapid elevation of blood sugar does not occur and the secondary stimulation of the insulin secreting mechanism does not take place.

Conn suggested a diet composed of 120 to 140 gm of protein, from 50 to 75 gm of carbohydrate (initially 50 gm), and the

TABLE 91

ILLUSTRATIVE DIET FOR THE TREATMENT OF STIMULATIVE HYPOGLYCEMIA

Protein	130 gm	Carbohydrate	75 gm
Fat	154 gm	Calories	2,300

EXCHANGES	AMOUNT	PRO GM	FAT GM	CHO GM
Milk	2 cups	16	20	24
Vegetable—Group A	As desired	--	--	--
Vegetable—Group B	None	--	--	--
Fruit	2 exchanges	--	--	20
Bread	2 exchanges	6	--	30
Meat	15 exchanges	105	75	--
Fat	12 exchanges	--	60	--
		127	155	74

*Suggested Menu*

(The servings are the portions described in the representative exchange list)

*Breakfast*

Orange juice	4 ounces
Eggs, scrambled	2
Bacon, sliced, cooked	2
Toast	1 slice
Butter	1 teaspoon
Coffee	As desired
Cream	2 Tablespoons

*Dinner*

Clear broth	
Roast beef	7 ounces
Asparagus	As desired
Butter	1 teaspoon
Lettuce and tomato salad	As desired
Mayonnaise	1 teaspoon
Lemon gelatin*	As desired
Whipped cream	2 Tablespoons
Roll	1
Butter	1 teaspoon
Coffee	As desired
Cream	1 teaspoon
Milk	8 ounces

*Supper*

Roast chicken	6 ounces
Broccoli	As desired
Butter	1 teaspoon
Chef's salad	As desired
French dressing	1 teaspoon
Half grapefruit	1 medium
Coffee	As desired
Cream	1 teaspoon
Milk	8 ounces

\*Unflavored gelatin and lemon juice

remainder of the necessary calories provided from fats. The carbohydrate should be divided equally among a three meal program. Using the exchange method described in Chapter 30, an illustrative menu plan has been calculated which will meet the nutritional needs of the 25 year old "reference" woman of the the Recommended Allowances of the National Research Council (see Chapter 2). The calculations for this menu plan and a suggested menu will be found in Table 91.

The second type of stimulative hypoglycemia can occur when the insulin regulating mechanism is excessively stimulated by an abnormally high absorption of glucose. This condition is called **alimentary functional hypoglycemia** by Conn. Whenever the pyloric sphincter is removed from the gastrointestinal tract through surgical procedures, there is rapid delivery of food upon the highly absorptive mucosal lining of the small intestine. This in turn is likely to produce periodic spontaneous hypoglycemia as an excessive stimulus has taken place. The high protein, low carbohydrate diet regimen previously described has been effective in the treatment of this form of spontaneous hypoglycemia.

The **fasting hypoglycemia**, the second classification listed by Conn, has an abnormally low fasting blood sugar level. The hypoglycemia becomes more severe when there is a restriction of carbohydrate or when the patient fasts. Those conditions which may bring about fasting hypoglycemia are hepatogenic hypoglycemia, hypopituitarism, adrenal cortical hypoglycemia, and prolonged inanition. This classification of hypoglycemia occurs when there is not enough carbohydrate available to support tissue oxidation over any period of time. This may occur overnight or when a meal is omitted. The leading causes of fasting hypoglycemia are a disturbance of the normal function of the body's ability to form glucose from amino acids and fatty acids.

The dietary treatment in this type of hypoglycemia recommended by Conn is high protein high carbohydrate, and the remainder of the calories in fat. It may be necessary to include a bedtime feeding in this regimen.

There is a third condition known as **organic hyperinsulinism**, which is both a stimulative and fasting hypoglycemia according to Conn. This condition is also known as pancreatic insulinoma.

(tumor of the islets of Langerhans) Neither of the diets previously described proves satisfactory. Surgical intervention has alleviated the hypoglycemia.

Thus the dietary management of spontaneous hypoglycemia depends upon the diagnosis as to its cause. Once this has been ascertained the diets described in the preceding paragraphs may be applicable for a specific patient or another distribution of carbohydrate fat and protein may seem advisable. Those suggested are possible prescriptions. In planning the menus a great variety is possible within the framework of each exchange list. There are many interesting combinations such as custard desserts, casserole main dishes and cheese in many forms which are allowed. In addition it must be remembered that those foods having little or no calories listed in Table 84 in Chapter 30 may also be included in the diet. Recently Abrahamson\* has offered a thought provoking suggestion namely that hyperinsulinism with the subsequent hypoglycemia may result in nerve damage due to glucose starvation and may be a precursor of multiple sclerosis. He suggests the use of the Seale Harris Diet and intramuscular calcium.

### Review Questions

1. What is spontaneous hypoglycemia?
2. What are some of the conditions that may bring about spontaneous hypoglycemia?
3. What are the two classifications of hypoglycemia listed by Conn?
4. What are the conditions that are represented in each classification?
5. What is the blood sugar picture in each classification? How do the symptoms differ?
6. What are the diets suggested in the management of each classification? How do they fit into the metabolic picture?
7. How does the blood sugar curve in each classification of hypoglycemia differ from that of the normal individual?

### Suggested Project

1. Taking the same diet prescription as suggested in this chapter for stimulative hypoglycemia calculate a possible diet pattern for a 25 year old woman. (Or do the same for a 1 year old boy.)

\*Abrahamson L. M. N. York J. Med. 34 June 1 1954

## CHAPTER 32

### THE KETOGENIC DIET

The ketogenic diet, which is used primarily in treating epilepsy, consists of a calculated high fat, low carbohydrate regime. The degree of relief derived from this form of treatment is controversial. The diet is difficult to administer and is nutritionally inadequate. It is necessary that the patient remain on the ketogenic diet for at least several months to obtain maximum benefit.

The ketogenic diet is based on the theory that when the ratio of ingested fatty acid to glucose exceeds 2, ketone bodies circulate in the blood and produce a mild ketosis or acidosis (see discussion of the ketogenic antiketogenic ratio), a sedation which exerts a beneficial effect in several clinical conditions. The first use of this type of diet was for the control of epilepsy.

Epilepsy, a condition rather than a true disease, has been described for many centuries. Ancient writers attributed it to evil spirits and various attempts were made to drive them out. Although various theories have been advanced to explain the nervous mechanism involved in the precipitation of the attack or seizure, none is satisfactory. Some have observed that there might be heritable tendencies in epilepsy. The suggestion that it is due to some sudden change probably metabolic in origin in the physiochemical relationship within the brain has led to the attempt to control the attacks by dietary adjustment. However, no single specific change has ever been found at autopsy to be specifically associated with epilepsy.

In 1921 Geyelin called attention to the beneficial result which fasting exerted on epilepsy and recognized the part which acidosis plays. In the same year Wilder suggested the use of the ketogenic diet as a more practical and equally satisfactory method of treatment. Since then a measure of success has been obtained by the use of these diets especially in children.

Lennox and Cobb in 1928 stated that in certain epileptic persons who were subject to frequent seizures the attacks could be precipitated by lack of oxygen or by alkalosis and conversely these attacks could be prevented by increased oxygen intake and

by ketosis. Obviously, it is not practical to maintain patients in a condition of controlled oxygen or carbon dioxide tension, but it is possible to control their state of ketogenic antigenic balance.

McQuarrie later (in 1929) expressed the belief that the epileptic tended to retain water and that diuresis tended to postpone seizures and suggested that water restriction was of added value.

Today, there are approximately 800,000 people in this country who suffer from epilepsy. Through the increasing use of drugs and the aid in treatment from the electroencephalograph, control of epilepsy is progressing. The ketogenic diet does not play as great a part as it once did in the treatment of this disorder. It is difficult to ingest; it is unpalatable; it poses problems for the patient who must eat some of his meals out, and it is nutritionally unbalanced. Because of these objections it is infrequently recommended. However, some clinicians report a measure of success in the treatment of epilepsy in children by use of the ketogenic diet.

In administering the diet it is preferable to increase the fat slowly rather than to place the patient on the drastically different diet immediately. In some instances, however, an initial fast period has proved of value. The gradual increase in fat and the decrease in carbohydrate make possible eventually an F/A/G ratio of as high as 3:1 or 4:1 with a minimum of discomfort.

To calculate the ketogenic diet is simple; to fulfill the prescription is less easy. Since the ketogenic diet must be maintained over long periods, in some cases for life, the ketogeneity and low water intake must be the only factors of imbalance. The diet may be planned in a manner similar to that for the diet of the diabetic patient. (See Table 77.)

McQuarrie suggests that the total water intake be calculated as

- 30-40 gm per kilogram for the preschool child
- 20-30 gm per kilogram for the child from 5 to 10 years
- 15-25 gm per kilogram for the child 10 years and over

If the sodium chloride is held at the minimum level for safety of 2 to 3 gm daily, the possibility of water retention will be decreased.



Absolute adherence to the diet, except under certain conditions of drug therapy, is imperative if any degree of success is to be achieved. Minor adjustments may have to be made in order to adapt the diet to the individual, but these should be few. Discouragement must not be felt if no improvement is noticed within the first six months of dietary restriction. Long periods are sometimes necessary to bring about a noticeable effect. When the patient has been free from attack for several months under such a regime, there may be some relaxation in the ketogenicity of the ratio.

Lower protein levels are sometimes suggested than are here indicated and McQuarrie calls attention to the dangers of this practice on the basis of two facts: first that ketosis enormously steps up the patient's protein requirement, and also that protein starvation tends to increase water storage, and thus defeats the attempt at dehydration. McQuarrie suggests that protein levels up to 2 gm and over are more nearly adequate than that of 1 gm and under.

TABLE 92  
KETOGENIC ANTIKETOGENIC FOODS

KETOGENIC	ANTIKETOGENIC
Meats	Sugars
Fats	Starches
Some fish	Cereals
Egg yolk	Milk
Cheese	Fruits
Nuts	Vegetables

Again, using the 25 year old reference woman (see Chapter 2) as an example, a diet containing 2,300 might be divided into a ketogenic ratio by approximately the following prescription: Protein 63 gm, Fat 219 gm, and Carbohydrate 31 gm. Table 77 shows the possible calculations, by the exchange method, for such a prescription, and also it includes a day's possible menu. It has been found that many patients would prefer ingesting a high fat drink (somewhat like a glass of medicine) to having all foods covered with rich sauces. Thus, in Table 93 a drink which may be given in two "doses," midafternoon and evening is included. It is also advisable to include at least one "simple" food, that is one food that is not high in fat, at each meal.

TABLE 93  
ILLUSTRATIVE KETOGENIC DIET

Protein 1 pt	63 gm 210 gm	Carbohydrate Calories	11 gm 2,700	
FOOD	AMOUNT	PRO GM	FAT GM	CHO GM
Milk, whole	1½ cup	4	5	6
Vegetable—Group A	4 exchanges	--	--	--
Vegetable—Group B	None	--	--	--
Fruit	1 exchange	--	--	10
Bread	1 exchange	3	--	15
Meat exchanges	8 exchanges	56	40	--
Fat	35 exchanges	--	175	--
		63	220	31

## Suggested Menu

<i>Breakfast</i>	
Orange juice	4 ounces
Egg scrambled	1
Butter	2 teaspoons
Bacon	3 slices
Toast	1 slice
Butter	1 teaspoon
Coffee	As desired
40% cream	2 Tablespoons
<i>Noon</i>	
Roast beef	3 ounces
Asparagus	1 serving
Butter	2 teaspoons
Lettuce wedge	
Mayonnaise	2 teaspoons
Lemon gelatin*	
Whipped cream	2 Tablespoons
Coffee	As desired
40% cream	2 Tablespoons
<i>Mid-afternoon</i>	
½ special high fat "drink"†	
<i>Dinner</i>	
Roast chicken	3 ounces
Broccoli	1 serving
Butter	1 teaspoon
Tossed green salad	1 serving
French dressing	2 teaspoons
Bavarian cream‡	One portion
Coffee	As desired
40% cream	2 Tablespoons
<i>Evening</i>	
1 special high fat "drink"†	

\*Lemon Gelatin  
Plain unflavored gelatin  
Lemon juice  
Saccharine  
†High fat drink  
½ cup milk  
1 cup 40% cream  
1 egg

1 teaspoon vanilla  
Nutmeg  
‡Bavarian Cream  
Plain unflavored gelatin  
40% cream  
Saccharine  
Vanilla

The curtailment of carbohydrate in the form of cereals and cereal products and the curtailment of milk because of its water and sugar content bring about a deficiency of the B vitamins in the diet, and a commercial source of this complex must be used. Because of the curtailment of milk, the diet is also deficient in calcium. This is a matter of importance in child patients and their diets must include calcium supplementation. Cheese can partially replace milk, or for young children a milk substitute may be prepared by mixing 40% cream with 4% calcium caseinate in water, which has been sweetened to taste with saccharine.

Fruits and vegetables served as salads prevent loss of vitamins and minerals and also act as vehicles for large quantities of cream or mayonnaise dressings.

Egg yolk is preferable to the whole egg and may be used as garnish, made into noodles by slowly adding it to rapidly boiling liquid and beating with a fork to break into shreds or it may be scrambled with butter or cream.

Forty per cent cream should be used because it has a lower water and higher fat content than lighter cream.

Ice cream, custard, puddings made from cream, egg yolk, saccharine, and flavorings all may be eaten. Diabetic or unflavored gelatins may be prepared using cream as the liquid. In most cases foods which contain a negligible amount of carbohydrate, such as those listed in Table 84, may be included in the diet.

Gluten products, breads, cereals, muffins, cookies, etc., are justifiable on this type of diet. They are starch free and since the fatty acid and glucose are approximately equal they can become ketogenic by acting as carriers of butter. In addition they make possible the inclusion of bread and cereal in the diet.

The ketogenic diet is also used in the treatment of migraine and for infections of the urinary tract.

### Review Questions

1. What theory is the basis for the ketogenic diet?
2. For what conditions might this diet be used?
3. In addition to the ketogenic diet, what other means are used to prevent seizures in the epileptic?
4. What adjustments from the normal are made in the food nutrients in the ketogenic diet prescription?

- 5 What range of percentage of the total calories may be given as protein? What range for fat? Carbohydrate?
- 6 What ratio of F.A.G. may safely be used?
- 7 What are the indications in regard to water and salt in conjunction with the diet?
- 8 What foods are used in filling a ketogenic prescription?
- 9 What are the objections to the ketogenic diet? How may some or all of them be remedied?

### Suggested Projects

- 1 Calculate a ketogenic prescription for a 10 year old girl according to the pattern set forth in Table 77. Calculate a food pattern, using the exchange method, and then plan a day's menu from the calculated food pattern. Evaluate the nutritional value of the menu. In what nutrients is it lacking (use the recommended allowances of the National Research Council as a standard in Table 3)? Can you modify the pattern to remedy any or all of these deficiencies (if they exist)? What percentage of the day's need must be supplemented from vitamin concentrates?
- 2 Answer the same questions listed in No. 1, using a 65 year old woman who must eat all of her meals away from home as your possible patient. What special difficulties might she have that another patient might not encounter, difficulties in following a ketogenic diet?

amounts of fruits and vegetables should be used, and a fish oil preparation should be supplied as a source of vitamin D

Such a diet takes cognizance of the recent theories underlying the dietary treatment of arthritis and combines them into a well balanced diet. Adjustment in bulk content can easily be made whenever necessary. The diet may be liquid, soft, smooth, or high in roughage. In making adjustments, care should be taken to maintain adequacy. The vitamin B complex, especially vitamin B<sub>1</sub>, and vitamin C should be added if they are not supplied in sufficient amount in the foods chosen.

So far as rheumatoid arthritis itself is concerned, the diet should be a balanced normal diet, rich in vitamins, minerals, and protein, low in calories to maintain body weight. However, since their discovery, ACTH and cortisone have been used in the treatment of many cases of rheumatoid arthritis. Because of the influence of these hormonal medications upon the electrolyte balance of the body, it is usually necessary to place the patient upon a low sodium diet. When this occurs, the diet principles described for arthritis are combined with those outlined in the low sodium regimen (see Chapter 39). Of course, the extent to which both the sodium and the calories are restricted is based upon the individual needs of each patient.

**Degenerative arthritis** is a condition which accompanies advancing years. According to general opinion it has little cause other than that due to the wear and tear of "long continued trauma." It is usually insidious in its onset and appears with equal frequency in both sexes after 40 years of age. From a dietary standpoint it is usually suggested that if the patient is overweight, he reduce. Other than that, a normal diet, similar to the one indicated for rheumatoid arthritis, is usually prescribed.

**Gout** is a metabolic disturbance in which uric acid is excreted with difficulty by the kidneys, the acid is raised to a high level in the blood, and, as a consequence, the sodium salt of the acid (sodium urate) is deposited in various parts of the body. This abnormality Hench suggests is probably a result of, rather than the cause of gout. Gout occurs predominantly in men, is usually associated with overweight, has its onset around or after middle life, and is markedly hereditary in occurrence. The attack, which appears as an inflammatory process, is characterized

by swelling local heat redness and pain in one or more joints. The great toe especially is involved. Eventually permanent changes result from gouty deposits.

Uric acid is a normal constituent of blood arising from two sources—exogenous or from food and endogenous or from the body's own tissues. It arises from the breakdown of nucleoproteins (see Chapter 5 Proteins) of plant and animal cells. Nucleoprotein as a result of the metabolic process is broken down into purines which in their turn are oxidized to uric acid. Under ordinary conditions the body readily excretes the excess uric acid in the urine but in gout for some obscure reason excretion is impaired. The endogenous uric acid cannot be altered since breakdown of body tissues goes on throughout life; the exogenous fraction can be controlled by diet. It has been found recently that uric acid may be synthesized within the body from simple carbon and nitrogen compounds. Although a high uric acid concentration in the blood accompanies the deposition of sodium urate in gout there is no evidence that hyperuricemia is the sole cause of this urate deposition.

Although the cause for gout is unknown many foods have often been accused as being the precipitating factor. It has been suggested that eating foods rich in purines, foods rich in protein, habitual dietary excesses and periodic indulgence in alcoholic beverage will bring about an attack of gout. Bauer and Klemperer writing in Duncan's *Diseases of Metabolism* point out that these suggested relationships between the intake of certain foods and the consequent gout have not been sufficiently established by scientific research.

In the past the diet used in gout was traditionally low in fat, essentially free or low in purines and only moderately high in total protein. However because of the newer beliefs concerning purine metabolism there is no general agreement in the dietary regimen. Some clinicians rigidly restrict the purine content of the diet, others restrict those foods especially high in purine content. Both suggestions will be included in the following discussion.

Glandular organs, liver, kidney, sweetbreads (thymus and pancreas) are especially rich in nucleoproteins. Muscle is relatively rich as is the germ of grains and the actin part of plants such as the tips of asparagus, the

or beans, etc. Most vegetables are essentially purine free, fruits and the milled grains or cereals are entirely so. Inasmuch as the germ is attached to whole grain cereals, in this form, they are precursors of purines. Milk is purine free, as are also hen's eggs. Table 94 gives details concerning the purine content of most

TABLE 94

PURINE CONTENT OF VARIOUS FOODS (J. SCHMID AND G. BESSAU)\*

100 GM	BASES N IN GRAMS	URIC ACID IN GRAMS	100 GM	BASES N IN GRAMS	URIC ACID IN GRAMS
<b>Meat</b>			<b>Roquefort cheese</b>		
Beef	0.037	0.111	Cream cheese	0.005	0.015
Veal	0.038	0.114	Dairy cheese	0.027	0.066
Mutton	0.026	0.078	<b>Vegetables</b>		
Pork	0.041	0.123	Cucumber	0	0
Boiled ham	0.025	0.075	Lettuce	0.003	0.009
Smoked ham	0.024	0.072	Radish	0.005	0.015
Smoked salmon	0.017	0.051	Cauliflower	0.008	0.024
Smoked tongue	0.055	0.165	Garlic	Traces	Traces
Leberwurst	0.038	0.114	Sprouts	0.024	0.072
Blutwurst	0	0	Carrot	0	0
Brains	0.028	0.084	Green cabbage	0.002	0.006
Liver	0.091	0.279	Red cabbage	0.007	0.006
Kidney	0.080	0.240	Rape kale	0.011	0.033
Sweetbread	0.330	0.990	Celery	0.005	0.015
Lungs	0.052	0.156	Asparagus	0.008	0.024
Chicken	0.029	0.087	Onions	0	0
Squab	0.058	0.174	String beans	0.002	0.006
Goose	0.033	0.099	White potatoes	0.007	0.006
Veal	0.039	0.117	Shell beans	0.027	0.081
Pheasant	0.034	0.102	Peas	0.018	0.054
Bouillon (100 gm beef)	0.015	0.045	Lentils	0.034	0.162
<b>Fish</b>			Beans	0.017	0.051
Shellfish	0.039	0.117	Mushrooms	0.018	0.054
Codfish	0.038	0.114	<b>Fruit</b>		
Eel (smoked)	0.027	0.081	Bananas	0	0
Salmon (fresh)	0.024	0.072	Pineapple	0	0
Carp	0.054	0.167	Peaches	0	0
Pike	0.045	0.135	Grapes	0	0
Pike	0.048	0.144	Tomatoes	0	0
Red herring	0.028	0.084	Pears	0	0
Herring	0.069	0.207	Plums	0	0
Trout	0.056	0.168	Whortleberries	0	0
Sprout	0.082	0.246	Oranges	0	0
Sardines	0.118	0.354	Apricots	0	0
Sardel	0.078	0.234	Blueberries	0	0
Anchovies	0.145	0.465	Apples	0	0
Crabs	0.020	0.060	Almonds	0	0
Oysters	0.029	0.087	Hazelnuts	0	0
Lobster	0.022	0.066	Walnuts	0	0
<b>Eggs</b>			<b>Cereals</b>		
Hens eggs	0	0	Grits	0	0
Caviar	0	0	Barley	0	0
Shad roe	0	0	Rice	0	0
<b>Milk and Cheese</b>			Tapoca	0	0
Milk	0	0	Sago	0	0
Edam cheese	0	0	Oatmeal	0	0
Swiss cheese	0	0	Millet	0	0
Limboger cheese	0	0	Rolls	0	0
Tilsit cheese	0	0	Light bread	0	0

\*From *Therapeutics of Internal Diseases* by Forchheimer D. Appleton Century Co

foods. Table 95 indicates a dietary regimen which might be followed when a low purine diet is indicated.

From the tabulation it is evident that meats, fish, and poultry must be strictly limited, while glandular meats must be eliminated entirely. Protein must be derived almost entirely from milk and egg. For palatability, a small serving of muscle meat

TABLE 95  
ILLUSTRATIVE LOW PURINE DIET

*Include these foods each day*

- Milk—1 pint
- Meats, poultry, or fish—2 oz. of all (Group II) except those excluded (Group I)
- Eggs—at least one or more
- Bread, cereal, cereal products—as desired
- Potato—as desired (except fried)
- Vegetable, green leafy—all except limited amounts of those listed in Group II
- Vegetable, other—all except limited amounts of those listed in Group II
- Fruit, citrus—at least one serving
- Fruit, other—at least one serving
- Fat—butter, fortified margarine, oils, cream—as desired
- Miscellaneous—coffee, cocoa

*Group I—Foods omit (high purine content)*

- |               |          |           |                          |         |
|---------------|----------|-----------|--------------------------|---------|
| Liver         | Kidney   | Anchovies | Mussels                  | Alcohol |
| Sweetbreads   | Sardines | Squid     | Scallops                 |         |
| Meat extracts | Gravy    | Goose     | Yeast bakers and brewers |         |

*Group II—Limited amounts (moderate purine content)*

- |               |             |           |
|---------------|-------------|-----------|
| Beef          | Game        | Beans     |
| Veal          | Fowl        | Pears     |
| Mutton        | Fish        | Lentils   |
| Lamb          | Shellfish   | Spinach   |
| Pork          | Fish pastes | Mushrooms |
| Pork products |             |           |

*Group III—Eat freely (negligible purine content)*

- |        |                           |                     |           |        |
|--------|---------------------------|---------------------|-----------|--------|
| Milk   | Mayonnaise                | Breads              | Sugar     | Tea    |
| Cheese | Vegetable oils            | Cereals             | Nuts      | Coffee |
| Butter | Fruits (all)              | Cakes, cookies etc. | Gelatin   | Cocoa  |
| Eggs   | Vegetables (except above) | Sweets              | Ice cream |        |

is permitted once or twice a week possibly leading up to daily use, depending upon how drastically the diet must be curtailed. Finely milled cereals and fruits are consumed as desired, as are vegetables, with the exceptions previously noted. The normal diet contains from 600 to 1,000 mg. of purines daily, a low purine diet contains from 100 to 150 mg.

Further restrictions are thought to be of clinical value, namely, a total caloric intake decreased somewhat below the normal value for the individual when in health. A slight state of undernu-



trition is much to be preferred to obesity. A weight below normal by 10 to 15% is satisfactory. High caloric intake, regardless of type of food ingested, predisposes to attacks, which is an added reason for caloric restriction.

The total protein level for the patient with gout is planned not to exceed 1 to 1¼ gm per kilogram of body weight. High protein, even though it is purine free, tends to raise the uric acid level of the blood. Restriction of fat is thought by some to be of value in decreasing the severity and the frequency of the attacks. It has been suggested that fats inhibit purine excretion. Levine pointed out that it has been observed that a high fat intake seems to predispose to acute attacks of gouty arthritis.

Coffee and tea contain caffeine, which, in turn, contain purine bodies that some believe may be converted into uric acid. Those who advocate a low purine diet usually restrict the coffee and tea intake to one cup per day. Those who follow a more liberal regimen, such as that suggested by Levine and Bauer and Klemperer (references cited in Appendix), do not limit these beverages.

Alcohol is believed to aggravate the disturbance and is usually sharply curtailed. Rich, highly seasoned foods should be avoided, as should gravies, meat broth and meat stock soups. Sodium chloride should be used sparingly and water should be taken in abundance. Last, but by no means least the diet should be continued in conjunction with strict adherence to general rules of health.

TABLE 96

FOODS OMITTED ON A MODERATELY RESTRICTED DIET IN THE TREATMENT OF GOUT

FOOD	PURINE CONTENT MG /100 GM
Sweetbreads	825
Anchovies	360
Sardines	300
Liver	230
Kidneys	200
Brains	195
Meat extracts	150

Bauer and Klemperer question the need of drastic dietary restrictions. They contend that nowhere have they found sufficiently well controlled dietary studies involving uric acid levels, dietary changes, and the clinical course of the disease. Their treatment is

avoidance of overweight and a diet which contains adequate amounts of protein, iron and vitamins. They feel that drastic curtailment of purine intake results in a "monotonous and unpalatable diet," as well as one conducive to the development of deficiencies. They restrict only excessive purine intake through the foods listed in Table 96.

Since the values given for the purine value of foods in their opinion are controversial and since the amounts, other than those previously indicated are small they can be neglected in the diet planning. They even permit small amounts of alcohol. The preferable type of treatment therefore, is still open to question.

During an attack of gout which is usually of short duration the diet adjustment may need to be drastic. At this time a purine free diet is often followed. This consists of a moderate amount of skim milk in abundance of fruit and fruit juices cereal with milk crackers and large quantities of water. When the attack is over either the diet outlined in the general discussion as low purine or the one recommending moderate purine restriction should again be followed.

### Review Questions

- 1 Differentiate between rheumatoid arthritis and degenerative arthritis.
- 2 What at the present time is considered the best diet for patients with arthritis?
- 3 Upon what theory is this diet based?
- 4 What other modifications may be made of the diet in arthritis?
- 5 What is gout? What are the characteristics of gout?
- 6 What is the relationship between purine metabolism and the uric acid content of the blood?
- 7 What adjustments of diet are believed necessary in treating gout?
- 8 What foods are highest in purines? What foods may be eaten freely?
- 9 During an acute attack what type of diet is advised?

### Suggested Projects

- 1 Interview a patient with gout. Discover if he himself has noticed any relationship between the foods that he eats and the incidence of attacks. What is his reaction to the diet prescribed for him? How liberal is the diet in terms of the discussion in the chapter?
- Examine your own weekly menus. What modifications would you have to make to have a low purine diet? Are these changes compatible with your food pattern? What problems would you encounter if you followed this diet?

the elimination of potassium is increased. Renal function is restored and the accumulation of nonprotein nitrogen in the blood is reduced. However, the administration of desoxycorticosterone does not correct the defect in carbohydrate metabolism and the diet must contain large amounts of readily available carbohydrate. This can be accomplished by three small meals with interval and bedtime feeding. Usually, when the patient is receiving hormonal therapy, sodium chloride is also given. Most clinicians have indicated that a diet low in potassium is not necessary at this time. It is necessary to maintain a fine balance between the amount of desoxycorticosterone and sodium chloride administered to the patient. This, of course, is determined in the initial prescription and the sodium content of the diet is adjusted accordingly.

Before hormonal therapy was instituted in 1929 and today, with certain patients, it is necessary to reduce the intake of potassium in the food from the normal 4 gm. daily to about half that amount. This can be accomplished by the omission of certain foods and by the special preparation of others. Cantrow\* lists four basic steps whereby this may be arranged.

- (1) Limit the selection of bread, cereal, and sugar to highly refined products.
- (2) Avoid those soups, broths, and gravies which contain meat stock or meat extracts, catsup, chili sauce, mustard, and other meat sauces and seasonings, dried fruits and vegetables, bran, molasses, Postum, and chocolate.
- (3) Restrict moderately the use of milk, meat, fruit, vegetables, and condiments.
- (4) Meat and vegetables should be cooked by a special method whereby their potassium content is lowered. The latter and meat should be cut into small pieces and cooked in six to eight times their bulk of water in Patapar (parchment paper) bags. By this method the potassium content of vegetables may be reduced 60 to 70% and that of meats about 75%.

The tables of potassium and sodium chloride content of foods of value in planning the dietary of the patient with Addison's disease are listed in the Appendix, Tables 124 and 124A.

The diet of these patients may follow the schematic outline for the normal diet, with special emphasis on liberal intake of protein and carbohydrate, moderate use of foods of high calcium

\*In Duncan Diseases of Metabolism, ed 3 W B Saunders Co, p 303

content, curtailment of potassium, liberal use of foods high in sodium chloride, and generous intake of water. The diet must be adequate calorically to correct weight loss or to maintain weight. Fat is a logical means of increasing calories if a distaste for fat does not ensue. Carbohydrate may be increased by the use of candy, sweetened drinks, and other means.

The curtailment of whole grain cereals, the discarding of the cooking water of vegetables, the restriction of certain vegetables and fruits, and the limitation on milk intake result in a dietary low in vitamin B complex. Supplementation by commercial vitamin B, and probably also by ascorbic acid (vitamin C) is, therefore, necessary. Experimentation is reported that suggests beneficial results from generously increased amounts of vitamin C. The normal adrenal gland contains a high percentage of ascorbic acid.

Future developments in therapy for this condition are awaited with keen interest. Fortunately, Addison's disease is not common. It occurs in the third to fifth decades of life, and most commonly in males.

### Review Questions

- 1 Describe the metabolic disturbances that have occurred in Addison's disease.
- 2 What are the early symptoms of this condition? What symptoms follow?
- 3 What changes in the blood picture occur in this disease?
- 4 What are the principles of the dietary management of this condition?
- 5 How may the normal diet be modified in Addison's disease?
- 6 How do these modifications affect the nutritional value of the diet? If adjustments need to be made what might they be and how might they be accomplished?

### Suggested Projects

- 1 Prepare either meat or vegetables in the manner suggested in the preceding paragraphs. Note the length of time it takes you to prepare the food. Do you care for the flavor of the food? The texture? What problems do you think a patient might encounter if he prepared his foods in this way every day?
- 2 Using the tables of potassium and sodium chloride content of foods in the Appendix, calculate a day's menu for the 25 year old adult woman that contains 2 gm of potassium. Is the menu adequate in other nutrients? If not, which ones are lacking? Can you remedy this by a change in food?

## CHAPTER 35

### DISORDERS OF THE GASTROINTESTINAL TRACT

Most disorders which affect the gastrointestinal tract are the end results of errors in diet, disturbed motility and tone, or abnormalities in the secretory processes. Heredity, poverty, neurological or specific disease conditions may be associated causes. Other disturbances are common to the gastrointestinal tract but are not associated with specific disease entities. Among these are constipation, diarrhea, and flatulence. In the dietary treatment of gastrointestinal disorders, food may be modified in texture, consistency, composition, and type of service. In addition, the replacement of nutritional losses, the maintenance of a good nutritional state through individual diets are desirable.

Obviously any disturbance that interferes with the normal functioning of the gastrointestinal tract will affect the digestion and absorption of food. The reader is referred to Chapter 6 where the mechanics and hygiene of the gastrointestinal tract are discussed in detail. However, a brief résumé will be presented here. It will be remembered that there are essentially five sections or parts of the gastrointestinal tract: the mouth, the esophagus, the stomach, the small intestine, and the large intestine. The mouth receives food and prepares it mechanically for digestion. The breakdown of starches may take place to a small degree. The esophagus carries the food from the mouth to the stomach. In the latter organ, some protein digestion takes place, the food is stored for a short time, and the food mass undergoes further mechanical treatment until the food is in a liquid form when it passes into the small intestine. Here, the splitting of carbohydrates, fats, and proteins are completed, and eventual absorption of nutrients, vitamins, and minerals, as well as those mentioned previously, takes place. After the absorption of nutrients, the indigestible fiber and the waste products of digestion pass into the large intestine or colon. There, the excess water is reabsorbed, and the fecal mass is formed for eventual evacuation. Whenever there is hindrance of any form, such as an abnormality in the rate of gastrointestinal motility, an ob

struction or lesion or a disturbance in the secretory processes of the normal functions the diet of the patient has to be modified to refrain from aggravating the specific complaint. Also, the nutritional needs additional demands in some instances as well as the normal requirements should be administered.

### Disorders in the Mouth

As indicated above in the mouth if the teeth are intact, food is broken into fine particles mechanically and is mixed with saliva. Anything which interferes with these functions obstructs the first step in the digestive process and if for any reason the chewing of the food cannot be performed a diet must be adopted that is of such consistency as to obviate the need for chewing. Carcinoma, mouth injury or inflammatory conditions of the mouth tissues call for liquid diet. In ulceration inflammation or obstruction of the esophagus a liquid diet may be used. In inflammation of the esophagus the diet must be bland as well as liquid and in acute cases the condition may require gastrostomy (establishment of a gastric fistula) to prevent malnutrition or starvation. Cardiospasm (failure of the esophagus stomach sphincter to relax normally in the swallowing reflex) will call for a bland liquid diet which is neither excessively hot nor cold as the excessive temperatures have a tendency to interfere with normal reflex action.

### Disorders in the Stomach

Abnormalities of the stomach may be roughly divided into two classifications which might be termed *functional* and *conditional*. The former functional might refer to disorders related to the actual normal functioning of the stomach such as gastric atony, hyperchlorhydria and hypochlorhydria. The latter classification conditional may include abnormalities that may be a result of other disturbances which might bring about a singular disorder that affects the normal diet. These abnormalities would include acute and chronic gastritis, peptic ulcer, hemorrhaging ulcer and gastric obstruction.

An alteration of tone in which the stomach muscles fail to contract normally and food is retained in the stomach beyond the normal time is frequently called *gastric atony*. Smaller and

more frequent feedings, the use of a concentrated liquid diet or a smooth diet low in fat and low in total liquid may be used in this condition. This may be the soft diet described in Chapter 27. If it is low in fat it will not delay the normal emptying time of the stomach as a diet higher in fat would tend to do. In some cases attention to the B vitamins, especially thiamine, has been indicated. Frequently, with improvement in general health there is return to normal tonicity and an adequate diet is important as a means to this end. Gastric atony may be associated with a variety of other disorders as well as one phase of generalized muscular weakness. In some cases of hypomotility, the food may not leave the stomach and the stagnated contents may ferment and cause distress.

**Hyperchlorhydria** (hyperacidity) will result if hydrochloric acid is present in the gastric juice above the normal level of 0.2 to 0.4%. This condition, not a disease entity in itself, is frequently secondary to other pathological conditions and predisposes to the distressing gas acid eructations, "heartburn" etc. sometimes encountered. Nearly all patients with gastric ulcer and many high strung, nervous individuals show this increased stomach acidity. The acid is irritating to the tender mucous membranes of the stomach and, if unchecked, results in inflammation of the lining tissue. The degree of stomach acidity can be readily determined by gastric analysis. Treatment consists in decreasing or neutralizing the acidity. A low residue diet is used as pressure tends further to stimulate the acid producing cells. Stimulating foods are eliminated, and the diet must be bland but not tasteless—as frequently results by too low a level of seasoning in the zeal to eliminate stimulating ingredients (see Chapter 16, Food Adjuncts). The protein level should be high since in the process of digestion the protein ties up with the gastric hydrochloric acid and reduces the amount left free. Milk, cheese, gelatin and eggs are preferable to meat because the extractive content of meat has a stimulating effect. Fat tends to depress the secretion of gastric juice, and, hence, decreases the outpouring of the acid. Concentrated foods, such as sweets, extremely hot or extremely cold foods which are stimulating, pastries, fried foods, and hot breads which are difficult to digest, and alcohol are contraindicated. Coffee and tea in moderation are

permitted. Treatment also includes a search for the probable contributory cause and its alleviation which in turn will relieve the stomach acidity.

The reverse condition known as **hypochlorhydria** (hyporecidity and achlorhydria the absence of hydrochloric acid in the stomach) likewise occurs and is related to a number of such clinical conditions as Addison's disease pernicious anemia chronic alcoholism and myxedema. Indigestible residue in the diet is reduced to a minimum and easily digested nonirritating foods are included to decrease to a minimum the work of the stomach. It is reduced to a low level because of its depressing effect. Meat juices and fruit juices which tend to stimulate gastric juice flow are used. In this condition other gastric enzymes may be deficient or absent (*achylia gastrica*). It is then essential that foods which will leave the stomach quickly be given so that fermentation cannot take place. Here it must be remembered that attractive savory palatable food is conducive to a copious flow of gastric juice and that the act of chewing also sets up preparatory changes in the gastrointestinal tract. Crisp toast or crisp bacon or other foods which require chewing but which leave no residue are of value in initiating peristaltic waves.

**Gastritis**, acute or chronic is an inflammation of the mucous membrane of the stomach. By use of a gastroscope the stomach lining is seen to have undergone changes like those seen in other inflamed mucous membranes.

The cause of gastritis is not clearly defined but it may be from dietary faults such as rapid eating improper chewing it may be due to excessive alcohol or drugs or indirectly to a disease condition elsewhere such as pulmonary tuberculosis syphilis cirrhosis of the liver nephritis myocardial failure and polyarthritis. In addition acute gastritis may result from some ingested poison.

Dietary treatment is based on the same rules which govern any modifications of the normal diet—recognition of the abnormality and adjustment of the diet to it with precaution against development of a deficiency. It is recommended by some that patients with acute gastritis refrain from ingesting any food for one or two days. Then a full fluid diet that combines the physical modifications for a fluid diet with the chemical modifications



of a bland diet follows. The next step usually consists of a smooth bland diet, similar to the one found in Table 98. This diet is the most commonly used in chronic gastritis. Further adjustment may be necessary if either hypoacidity or hyperacidity exists. In addition, any possible correction of dietary faults that exist which may intensify the condition is made. These could include meals eaten slowly, food thoroughly masticated, and an elimination of those foods that had been found irritating (very hot foods and very cold foods, for example, are frequent offenders).

Ulcers, gastric and duodenal, receive the same dietary treatment. In the United States about ten times as many ulcers are duodenal as are gastric. Hyperacidity occurs in the majority of cases. As a rule, regardless of whether the ulcer is stomach or duodenal, it is located near the pylorus, and healing of a break in the mucous membrane is difficult because of the ever-present peristalsis and contraction and relaxation of muscles. The affected region is not only in constant motion but is constantly bathed by digestive juices and partially digested food. Even if the last factor could be eliminated, the other two would still remain. For this reason, fast periods and the use of duodenal tubes designed to pour the food directly into the intestine below the point of trouble are less satisfactory than might be expected.

The problem, then, is to provide an entirely adequate dietary which will not irritate or stimulate the affected part. The underlying principle is to provide a diet that is "chemically, mechanically, and thermally nonirritating."<sup>\*</sup> Thus, chemically irritating foods that should be eliminated from the diet may be such items as spices, meat extracts, rare meats, condiments, vinegar, and so forth; mechanically irritating foods may be those that contain indigestible fiber, raw fruits and vegetables, tough fibers in meats, bran and whole grain cereals; and thermally irritating foods refer to extremely hot or cold beverages or desserts.

A second underlying principle is to provide foods that will neutralize the excess hydrochloric acid. Protein foods, especially milk and egg, will do this. In addition, fat has a depressing effect on hydrochloric acid. In order to maintain the neutralization of the gastric contents, frequent feedings are necessary.

<sup>\*</sup>Turner. *Handbook of Diet Therapy*, J. R. Lippincott Co., p. 125

These may be hourly, as in the case of severe ulceration, or, as the ulcer is brought under control, it may be only six small meals daily. An adjunct to food in maintaining neutrality is the administration of alkaline powders. The type of "alkaline powders" and the method of their use vary considerably with physicians, and will not be described here. Belladonna in some form is also frequently used.

These principles give the basis for the ulcer diet, the milk cream diet so well known as the Sippy diet (sometimes spelled Sippi). This diet consists of equal parts (45 gm.) of milk and cream every hour for one week, then the gradual addition of cereal, cream soup, custard or junket at two of the feedings the second week. During the third week further additions are made, and so on. (See Table 97.) By the end of three to six weeks on the Sippy regime, depending upon the severity of the condition, the patient has had his diet increased from the liquid diet to the soft diet, is permitted to resume work and takes his food as three main meals a day with between meal feedings. He should continue to avoid such foods as raw fruit (except juices) and raw vegetables, nuts, spiced or highly seasoned foods, fried, rich, and excessively sweet foods or those which retard digestion, and alcohol.

TABLE 97

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Three ounces of a mixture of equal parts milk and cream are given every hour from 7 A.M. until 7 P.M. After two or three days soft eggs and well cooked cereals are gradually added, until at the end of about ten days the patient is receiving approximately the following nourishment: 3 ounces of the milk and cream mixture every hour from 7 A.M. until 7 P.M. and, in addition, three soft eggs, one at a time, and 9 ounces of a cereal, 3 ounces at one feeding, may be given each day. The cereal is measured after it is prepared.

Cream soups of various kinds, vegetable purées, and other soft foods, may be substituted now and then, as desired. The total bulk at any one feeding while food is taken every hour should not exceed 8 ounces. Many of the feedings will not equal that quantity. The patient should be weighed. If desired and tolerated, a sufficient quantity of food may be given to cause a gain of two or three pounds each week.

A large variety of soft and palatable foods may be used, such as jellies, marmalades, custards, creams, etc. The basis of the diet, however, should be milk, cream, eggs, cereals, and vegetable purées. Lean meat is not given during the period of accurate observation, since it interferes with the tests for occult blood in the stool and aspirated stomach contents.

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TABLE 93

## ILLUSTRATIVE BLAND DIET

**General Rules**

Small frequent feedings

Avoid extremely hot and extremely cold foods

Avoid highly seasoned foods and foods mechanically irritating

**Include these foods each day**

*Milk*—at least one pint—buttermilk, whole or skim milk

*Meats, poultry, or fish*—4 oz is tolerated—tender, well done, broiled or roasted, without skins and tough connective tissue, may be minced

*Cheese*—cottage, farmer, or cream

*Eggs*—at least one, poached, soft or hard cooked, or scrambled in double boiler

*Bread, cereal, cereal products*—1 or more servings, cooked refined or enriched cereal, enriched toasted bread, crackers from refined flour, macaroni, noodles, spaghetti, refined rice

*Potato*—one serving, white potato, mashed, baked (served without skin), boiled, scalloped, creamed

*Vegetable, green leafy*—one serving, tender cooked (if tolerated) or puréed

*Vegetable other*—one or two servings, tender cooked (if tolerated) or puréed

*Fruit, citrus*—one serving strained orange juice, usually diluted with water

*Fruit, other*—one or two servings, ripe banana and avocado, canned or cooked fruits, without tough skin or seeds, puréed fruit or dried fruit

*Fat*—butter, cream, fortified margarine

*Miscellaneous*—cereal beverages, decaffeinated coffee, angel food or sponge cake, plain cookies or puddings, salt, gelatin, half milk half coffee, cream soups made with puréed vegetables, sugar in moderation

**Omit these foods**

*Meats, poultry, fish*—fatty, tough, rare, fried, salted, smoked or highly seasoned

*Cheeses*—strongly flavored, highly salted

*Eggs*—fried

*Breads, cereals and cereal products*—whole grain, bran, quick breads, bread not toasted, dry cereals

*Potato*—fried potato skins, fibrous yellow potatoes, potato chips

*Vegetable*—raw fibrous, or tough skins and seeds, highly seasoned

*Fruit*—raw (other than avocado or banana) skins and seeds

*Fat*—vegetable oils, meat fats, salad dressings, fried foods

*Miscellaneous*—meat extracts, gravy, broth, concentrated sweets, candy, jelly, jam, sauces (other than white sauce), condiments, herbs, spices, vinegar, nuts, pickles, relishes, foods preserved in salt, cakes, pastries, carbonated drinks, alcohol, coffee, tea, cocoa

There are a number of diets for use in ulcer. Einhorn feeds a formula of 240 cc of milk, 1 raw egg, and 15 gm of lactose every two hours for 8 feedings by duodenal tube. Lenhartz uses milk egg mixture every hour for five days then gradually adds scraped beef, boiled rice, toast, etc. Coleman advocates a diet of glucose

TABLE 99

## ILLUSTRATIVE CONVALESCENT ULCER DIET

**General Rules**

Six small meals each day

Avoid extremely hot and extremely cold foods

Avoid highly seasoned foods and foods mechanically irritating

**Include these foods each day***Milk*—at least one pint (usually one quart)—buttermilk, whole milk milk drinks*Meats, poultry, or fish*—4 oz tender well done, broiled or roasted meats as tolerated, bacon, sweetbreads; white fish, canned tuna or salmon*Cheese*—cream, cottage or farmer, American used for flavoring or as tolerated*Eggs*—at least one, poached, soft or hard cooked, or scrambled in double boiler*Bread, cereal, cereal products*—4 or more servings—cooked refined enriched cereal, crumbled toasted bread, crackers from refined flour, macaroni, noodles, spaghetti, refined rice*Potato*—one serving white potato, mashed, baked (served without skin), boiled, escalloped, creamed*Vegetable, green leafy*—one serving tender cooked*Vegetable, other*—one or two servings tender cooked, puree of corn and Lima beans*Fruit, citrus*—one serving strained orange juice, others as tolerated*Fruit, other*—one or two servings—ripe banana and avocado; canned or cooked fruits without tough skin or seeds, pureed fruit or dried fruit*Fat*—butter, cream, fortified margarine vegetable oils as tolerated*Miscellaneous*—weak tea and coffee, or half milk half coffee, cereal beverages, decaffeinated coffee, weak cocoa, angel food or sponge cake plain cookies, puddings made from the above foods, gelatin, cream soups made with pureed vegetables, plain candy, sugar, syrups, clear jelly in moderation**Omit these foods***Meats, poultry, fish*—tough, rare, fried, salted, smoked, or highly seasoned*Cheeses*—strongly flavored, highly salted*Eggs*—fried*Bread, cereals and cereal products*—whole grain, bran, quick breads, bread not toasted, dry cereals*Potato*—fried, potato skins, fibrous yellow potatoes, potato chips*Vegetable*—raw, fibrous, or tough, skins and seeds*Fruit*—raw (other than avocado or banana), skins, and seeds*Fat*—meat fats, salad dressings, fried foods*Miscellaneous*—meat extracts, gravy, broth, sauces (other than white sauce), condiments, herbs, spices, vinegar, nuts, pickles, relishes, foods preserved in salt, cakes, pastries, carbonated drinks, alcohol, jam, marmalade, and large amounts of concentrated sweets, such as candy, jelly, syrup and sugar

olive oil, egg white, salt, and water. Seale Harris uses a diet similar to the Sippy, but includes orange juice at regular intervals with the milk and cream mixture. The addition of orange juice supplies the vitamin C so essential for the healing process.

A modification of the Sippy diet is the method most generally used. As a rule, the patient should stay in bed for three to four weeks. Feeding is begun immediately without any preliminary starvation period. Some hospitals have a progression of diets, called by such names as Bland Diet I, Bland Diet II, Bland Diet III, and so on. While the Sippy form of treatment is excellent medical procedure, it must be individualized the same as any other diet to meet the needs and pleasure of the patient.

One disadvantage of this diet is the marked deficiency of ascorbic acid, a vitamin so essential for tissue healing. It is also low in thiamine, riboflavin, niacin, and iron. In addition, it requires sodium chloride if mineral balance is to be maintained under calcium carbonate therapy. Pollack and Halpern (in *Therapeutic Nutrition*, NRC Bulletin No. 234) point out that the conventional diets used for the initial treatment of peptic ulcer are inadequate both in proteins and in calories. To illustrate further they estimate that the first week's menus for a typical modified Sippy diet provide only 50% of the protein requirements of a healthy individual. The menus that are used later in the treatment of ulcers may contain just 75 to 80% of the recommended daily protein and calorie allowances. In order to supply the protein necessary for the treatment of peptic ulcer, Pollack and Halpern suggest that the patient should receive a minimum of 100 gm. of protein a day. They recommend that this can be accomplished by adding protein concentrates to the milk and cream feedings.

Alvarez states that while the Sippy diet brings good results, it is too elaborate for general use and requires more than meager intelligence or ordinary nursing care to follow it. He has devised an ambulant form of treatment which can be followed by the patient who is up and about. It is particularly adaptable to the patient with duodenal ulcers which are less prone to become malignant than are gastric ulcers. Alvarez permits his patients to remain at work and to have three meals a day, the smooth, nonirritating meals essential in any gastrointestinal lesion. Between meals the patient receives a feeding of the following mixture: 1 quart of milk, 2 eggs,  $\frac{1}{2}$  pint of cream. This may, in part, be taken to work for a midmorning and a midafternoon meal, and the remainder may be consumed in the two evening snacks, or one in the night if the patient awakens. If the mixture is

not available at the correct time Alvarez advises a milk shake or malted milk at a soda fountain or a dozen malted milk tablets. The patient must do no heavy work such as lifting or gardening; neither must he enter into any recreational activities other than walking. Supplementation of the diet by commercial vitamin products is usually desirable and experience has shown that a vitamin intake well above normal (approximately double) is advisable. Because fruits and vegetables are drastically curtailed in this diet there is danger of deficiencies of the vitamin B complex, vitamin C and possibly vitamin K.

Other methods of treatment of peptic ulcer have been reported in the literature recently. One is a regimen of frequent medication by the administration of several tablets which allows the patient to enjoy an unlimited diet. Banthine, an anticholinergic drug, has received support from some clinicians. This is administered orally. The existence of an antipeptic ulcer vitamin or factor has been reported. It has been called vitamin U and seems to be present in several raw foods, cabbage, other green vegetables, milk, butter, and egg yolk. This factor is quickly destroyed by heat and has been found by Cheney to be related to the formation and healing of ulcers. These are all encouraging steps in the treatment of peptic ulcer so that soon the usual regimen may include these newer methods.

Recurrences of ulcers are not infrequent in individuals who considered themselves cured and had resumed the completely normal diet. Prevention of recurrence should also include mental peace so far as it can be attained, adequate rest and avoidance of violent exercise. Fatigue, emotional upset and infection are causes of the frequent recurrence of ulcers. Incessant care and adherence to the necessary rules of health are important for all ulcer patients.

If hemorrhage occurs, rest is imperative, physical, mental and alimentary. Sedatives will probably be necessary. Just how long food must be withheld is a question. Some authorities believe that nothing should be given by mouth until all bleeding stops and others contend that frequent feedings neutralize the gastric juice and prevent the juice from digesting the forming blood clot. Meulengraet following this latter viewpoint recommends a diet of small frequent feedings of puréed meat, cooked fruits, puréed vegetables, cooked cereals, eggs and milk from

the first day of hemorrhage. Others would use a neutralizing drip (by means of a Levine tube) to prevent clot digestion and withhold food which might dislodge the clot. Still others prescribe feedings of milk gelatin and possibly orange juice until they believe a clot has formed and more food may be tolerated.

The type of treatment will vary with severity of the condition its source the age and general health of the patient. Surgery may need to be employed. Postoperatively the ulcer patient may have to limit his menus to small frequent feedings of simply prepared foods. His diet will depend upon the extent of the surgery and the condition of the patient.

Cancer in the gastrointestinal tract requires the same treatment as any other type of lesion although as time passes and the condition becomes progressively worse the liquid type of diet rather than increased food intake will probably become the order. Diet intake for the greatest comfort of the patient should be the rule. Smaller meals at more frequent intervals are usually the preferred course. The regime will be governed by location of the lesion stage of advancement whether surgical intervention is practical and the nature of the functional disturbance and secretory disorder. Varying degrees of obstruction may exist diminution of motor activity hyperacidity or hyporecidity. Anorexia is frequently present therefore palatability variety padding and attractiveness in service play an important part. Unless contraindicated the personal likes and dislikes of the patient should be given every attention.

**Pylorospasm** Just as spasm may occur at the cardiac end of the stomach it may occur at the pyloric end and prevent normal passage of stomach contents into the intestine with resulting stagnation gas formation and distention due to dilatation of the stomach (gastrectasis). A stenosis or constriction of the pylorus from any cause will bring about this same result. Surgical intervention is usually necessary and small frequent feedings of nonstimulating nonirritating soft foods accompanied by daily lavage (washing) of the stomach give relief and are the practice often necessary in preparing a patient for surgery.

### Disorders of the Small and Large Intestine

**Nervous indigestion** has been defined by McLester and Darby as a functional disorder of the gastrointestinal tract the mani-

festations of which are many and varied these may be the expression of chemical motor or purely sensory disturbances." Thus nervous indigestion is considered to be just one part of a total complex psychoneurosis. There are many situations which may upset a person's nervous imbalance such as overwork, grief and a severe illness. The dietary treatment is just one part of the total care of the patient. Of course the diet must be nutritionally adequate yet making adjustments for those specific foods that the patient believes he should avoid. He should be persuaded to cautiously add the "offending" foods to his menus until he is convinced that he can eat all foods. Although adjustments should be made initially the diet should not be restricted too rigidly. Obviously treatment has to be prescribed individually. Some patients may benefit from purced foods until they can progress to a more normal regime. McFester and Darby point out that the directions should be explicit not general or vague and that they should never be in a printed diet slip but the patient should feel they are individually given.

Flatulence or gas formation is a distressing and frequently found symptom. It occurs in health and in various disease conditions. Excessive gas production, inadequate expulsion or faulty absorption may be underlying causes. The habit of 'gas swallowing', bacterial action, allergy, loss of intestinal tone and secretion of blood gases into the intestinal tract all contribute to this condition. Certain foods are known to be gas forming in some individuals but not in all. Cabbage, cauliflower, Brussels sprouts, turnips, onions and the legumes are gas producing and are rich in hydrogen disulfide ( $H_2S$ ). Melons, spinach, cucumbers, radishes and raw apples are also in this category. Carbonated waters and mineral waters may cause discomfort. Molasses, honey and maple syrup and maple sugar are also offenders. All these foods may at times be valuable because of this very property for gas leavens the fecal mass and is an aid in combating constipation. A specific food may be gas forming for the individual patient at one time and yet may eat it without discomfort at another time. This seeming inconsistency may be due to factors other than the gas forming element within the food itself such as an emotional upset or a temporary illness.



Correction of flatulence requires elimination of the offending foods, or perhaps just an improved method of cooking. Hughes reports studies on healthy adults with whom certain foods disagreed, and found cooking methods to be an important factor. Overcooking, with resulting formation of decomposition products, definitely increased the number and intensity of the symptoms. Retention of volatile acids, by cooking the food in a covered kettle, also favored the decomposition of the sulfur compounds. Cooking vegetables until just tender not only preserves vitamin content but increases the digestibility. For maximum preservation of vitamin content, cooking vegetables in a small amount of boiling water in tightly covered vessels is the approved method and should be strictly adhered to except in cooking "strong-flavored," or more accurately, "sulfur-containing" vegetables. With such vegetables, vitamin loss is sacrificed to digestibility.

The use of a soft-low fiber diet reduced somewhat in carbohydrate, and from which rich foods and concentrated sweets are eliminated, may also be of value. The diet described in Chapter 27 is well adapted here. Eating and health habits, and psychic factors should be examined critically as possible contributors to the condition.

Diarrhea is a condition characterized by too frequent stools with more fluid consistency than normal. There is inadequate absorption of water by the body as the intestinal contents pass with unusual rapidity along the tract, or there is outpouring of water into the colon. Diarrheas are described as functional and organic. Kantor classifies the functional diarrheas as those which may occur in the normal person whose intestinal tract is exposed to an irritant, or who is allergic. They may occur as the result of putrefaction or fermentation, achlorhydria, endocrine disturbance, sprue and pellagra, nervousness, and a compensatory type associated with uremia or cutaneous burns. The organic diarrheas are caused by bacterial or protozoan invasion, poisons, and diseases, such as ulcerative colitis and regional ileitis.

The character of the stool, as determined grossly, microscopically, and chemically, gives evidence of the type of diarrhea and the causative agent. When these are known, the diet may be adjusted to combat or correct the abnormality. While gross examination does not always differentiate, a foul-smelling, dark

brown alkaline stool, for example, is, in general, due to putrefaction (proteolytic decomposition), and a light yellow acid stool showing gas bubbles is probably due to fermentative action on carbohydrate. In some cases the Schmidt Test Diet is frequently used for such diagnosis. It is usually given for about three consecutive days. It contains approximately 110 gm of protein, 105 gm fat, and 200 gm of carbohydrate which totals about 2,200 calories. (See Table 100.)

TABLE 100  
SCHMIDT TEST DIET

<i>Breakfast</i>	1 pint of milk* 50 gm of zwieback
<i>Midmorning</i>	1 pint of oatmeal gruel 40 gm rolled oats 10 gm butter 200 gm milk 300 gm water 1 egg salt
<i>Lunch</i>	150 gm chopped or scraped beef (raw weight), broil with 90 gm of butter 250 gm mashed potatoes
<i>Midafternoon</i>	Same as breakfast
<i>Supper</i>	Same as midmorning

\*If patient does not tolerate milk well substitute the following

1 liter cocoa  
90 gm cocoa powder  
10 gm sugar  
400 gm water  
100 gm milk

Putrefactive diarrhea resulting from bacterial action on protein requires a high carbohydrate low protein diet. If the diarrhea is caused by fermentation however the diet should be high protein and restricted carbohydrate. A fatty stool is indication of an inability to utilize fat normally. If starch particles are present starch must be restricted and a higher protein fat diet used. Only general rules can be given including the use of smooth nonirritating concentrated diets if the condition is chronic. Liberal fluid intake must be provided to prevent dehydration. Vitamin and mineral adequacy can be assured only

by increased intake, as in the rapid passage of matter in the intestine normal absorption cannot take place. Mucosa integrity must be maintained in spite of altered intestinal contents and motility. Vitamins are important for this purpose.

In acute diarrhea, water and minerals are important considerations, and both must be taken in liberal amounts. The diet should be drastically limited, and nothing should be given by mouth during the first twenty-four to forty-eight hours except water, tea, or broths. After this, gruels, baby foods, cream soups, and milk which has been boiled (to reduce the size of the curd) are all well tolerated. Some physicians prefer not to include milk in the list. Later, tender meat may be added to the diet. Fats, fruits, and sweets are contraindicated during an acute attack because of their laxative action. As the patient improves, the soft diet becomes the diet choice and is followed by additional food until the normal diet may be tolerated.

If the diarrhea is of the nervous type, treatment must be directed toward removing or relieving the cause, which may be psychic or due to mental or physical strain.

Frequently diarrhea, either chronic or acute, is a complicating symptom in nephritis, diabetes, paratyphoid infection, cholera or other intestinal infection or may be due to inorganic poisons, such as arsenic, mercury, iodide, or antimony. It may result from an allergy or from an overindulgence in food, or food that is laxative in nature or has been contaminated. The causative factor and also the extent of tissue involvement will determine the corrective or alleviating diet. But, in general, the regime given should prevail (see following discussion of Colitis). Sedatives, antispasmodics, and constipating medicine may or may not be necessary. Bed rest during an acute attack is mandatory.

Mucous colitis is regarded as a disorder primarily of the nervous system which manifests itself in the intestinal tract due to instability of neuromuscular control. The term mucous colitis is used because large quantities of mucus are passed in the stools. Constipation is usually present. The diet suggested in this disorder is a well balanced, smooth nonirritating diet which derives its bulk from soft indigestible fiber (see Chapter 7) rather than from the use of large quantities of vegetables and cereals. Agar likewise provides a smooth residue. The diet

should consist of milk cream eggs tender meats fruit juices pureed vegetables and either white or wheat germ or vitamin B reinforced bread which is devoid of all bran (see Cereals Chapter 3) The vitamin intake must be adequate and the vitamin B complex intake must receive special attention because of the curtailment of whole grain cereals. A commercial source of the B complex will be of value for instance *Vegetal yeast preparation* which fits easily into the dietary as a food product.

**Ulcerative colitis** a serious form of this disease affects the large intestine. Its cause is unknown. It may be an infection an allergic manifestation or a nutritional deficiency. These theories all have support. The disease naturally is intensified by emotional upsets inasmuch as an intimate relationship exists between emotional disorders and digestive functions. The mucosa is first edematous and diffusely hyperemic (excessive amount of blood) it bleeds readily. Later small abscesses form rupture and bleed. The entire colon may be involved. The symptoms appear insidiously with periods of remission and activity. Diarrhea and constipation accompany the disorder and once it is established it tends to become chronic.

The treatment entails prolonged bed rest a soft low fiber diet high in protein (150 gm) high in vitamins (double or triple normal intake) high in minerals and otherwise adequate. Malnutrition and anorexia are usually encountered. Occasionally sensitivity to certain foods develops unfortunately often to milk eggs oranges tomato and wheat. If milk is well tolerated the basic diet may well include two quarts daily. Padding with powdered milk may be used if the two quart bulk is too great. To compensate for the increase in protein fats should be curtailed. Commercial vitamins are employed. Hypovitaminosis due to faulty absorption has been suggested as a cause for continuance of the disease. Liver extract has been shown to have distinct value in some cases.

During acute stages of the disease the diet must be limited to liquids. It then progresses according to the condition of the patient through the soft diet to the diet for convalescence and in this form it is continued for life. Trial and error with intelligent watchfulness on the part of the patient in cooperation with the physician and ruling out of possible allergies is the wise method of adjusting the diet. Individual tolerances vary from

time to time, and individuals differ in regard to the foods which may be gas-forming. Tolerances for fats and starches vary with the individual also.

Constipation is probably the most common of these disorders, and it causes much needless worry. The idea that to be normal there should be a daily bowel movement has often led to the harmful practice of catharsis. Many individuals remain in perfect health with but one bowel movement every two or three days. Others may have several movements in one day habitually, with no indication of diarrhea. The amount of fecal matter passed daily varies considerably (100 to 400 gm. of moist fecal matter; see Composition of Feces) and is dependent somewhat upon the food ingested.

The idea has prevailed that when fecal matter remained in the body for several days, poisons were absorbed from it and caused the feeling of discomfort experienced in constipation. Alvarez points out that if absorption of poisons (autointoxication) were the cause of this discomfort, the symptoms would not disappear immediately upon defecation, as they always do, any more than one could "sober a drunken man by taking the bottle from his hip pocket"—a rather homely but well-pointed statement. The discomfort in constipation is probably of nervous origin from pressure on the mucous membrane, on the pelvic nerves, and perhaps slowing up or halting of normal peristalsis.

Intestinal autointoxication is a much abused and vaguely used term, indicating that poisons elaborated in the intestine are absorbed by the blood and passed through the circulation, leaving a trail of ills. The theory is that protein is the chief offender, and that the indican of the urine is a measure of the intensity of the reaction. As a matter of fact, poisons which are found in the intestinal tract are normally destroyed either in the intestinal mucosa or in the liver (see Chapter 37, discussion on functions of the liver). Alvarez, in his review of the subject of intestinal intoxication as a cause of disease, is quoted by McLester as offering the Scottish verdict of "not proved with an evident leaning toward not guilty."

McLester outlines the causes of constipation according to the classification of Spencer: (1) Dietary faults, deficient residue, or deficient liquid intake. (2) Interference with normal defeca-

tion reflex by lack of response or from injury to the nervous system as in *tiles dorsalis* or when defecation is painful as in fissures or hemorrhoids (3) The habitual use of laxatives and cathartics which frequently defeat their purpose by bringing on intestinal spasm from their irritating and inflaming qualities. If the purge is too drastic the entire large intestine is emptied and no material remains for evacuation the following day. Normally a certain amount of fecal material remains in the ascending colon and usually in the transverse colon after each evacuation (4) Lack of exercise which leads to weakness of skeletal muscles and lowering of tone. Any change in neuromuscular control of the bowel may lead to constipation (5) Stasis which from any cause allows time for extraction of abnormal amounts of water from the fecal mass so that a hard fecal mass results (6) Spasm of the intestine as a result of abnormal irritability or the presence of irritating material or both. Psychogenic influences may be a factor in this type of constipation.

Constipation may be classified in three general groups: atonic, spastic and obstructive. The terms are self explanatory.

In **atonic constipation** there is decreased muscle tone. The diet must be planned to stimulate the colon to evacuate normally. In the majority of cases this is best accomplished by foods with high indigestible fiber content, foods which will swell and retain their moisture such as agar, foods which will act as lubricants, fats and oils in general, gas forming foods which will lighten the fecal mass and stimulate by pressure and through abundance of water. Vitamin intake should be adequate especially the vitamin B factor which has specific effect on intestinal tone. Nicotinic acid and pantothenic acid are reported to be concerned with intestinal motility hence are important in this condition also. The establishment of regular habits of evacuation is advised and exercise to increase muscular tone.

**Spastic constipation** is essentially the opposite of the atonic type. In this condition the colon is subject to contractions or spasms accompanied by pain. This increased irritability may be the result of excessive use of laxatives or enemias, overingestion of condiments, alcohol or of foods which leave a harsh roughage such as bran (see discussion in Chapter 7). A diet planned to stimulate as little as possible the highly sensitive intestinal mucosa is used in this disorder. Logically it will be a smooth diet.

devoid of spicing and condiments, it will include no gas forming foods or stimulating foods, and at the same time it will be adequate for optimum nutrition. In some cases high fat diets are of value but not in cases where alternating diarrhea and constipation occur. The organic salts and acids of fruits have a mild laxative and stimulating effect on peristaltic action and may be used liberally in this type of constipation. Excess use must be guarded against to prevent overlaxation. Table 101 shows how a normal diet may be adjusted for a patient with atonic constipation and a patient with spastic constipation.

Obstructive constipation results from a block of varying degrees of completeness and necessitates surgical intervention. Until operation takes place, the diet must be without residue and must not be gas forming. The liquid or soft diet is used.

TABLE 101

## ILLUSTRATIVE MENUS FOR TWO TYPES OF CONSTIPATION

ATONIC CONSTIPATION	SPASTIC CONSTIPATION
<i>Breakfast</i>	
Orange sections Oatmeal with cream and sugar Whole wheat toast, butter Coffee, cream, sugar	Orange juice Farina with cream and sugar Enriched white toast, butter Coffee, cream, sugar
<i>Lunch</i>	
Cream of celery soup Sandwich Whole wheat bread Lettuce, bacon, tomato Mayonnaise Carrot sticks Fresh fruit cup	Cream of celery soup Cooked vegetable plate Spinach Julienne carrots Cauliflower flowerettes with cheese sauce Escalloped tomato Toasted enriched white bread Butter Baked apple—with cream Milk
Milk	
<i>Dinner</i>	
Tomato juice Roast beef gravy Baked potato, butter Broccoli with hollandaise sauce Lettuce wedge with dressing Whole wheat bread, butter Sponge cake Coffee, cream, sugar	Tomato juice Roast beef Baked potato, butter Buttered string beans Sliced banana, salad Enriched white bread, butter Baked custard Coffee, cream, sugar
<i>8 P. M.</i>	
Cheese crackers Milk	Plain cookies Milk

Occasionally it becomes necessary to prescribe a diet low in residue for the patient. This may be when it is undesirable for fecal material to enter the large intestine, either because of infection or, usually, as part of the regime following an operation on the colon. It is difficult to administer a low residue diet and there is little general agreement as to what may constitute such a diet. However, Table 102 lists foods that are considered by many to be low in residue and also those foods that are usually

TABLE 102

## ILLUSTRATIVE LOW RESIDUE DIET

**Include these foods each day***Milk**Meats, poultry, fish*—4 oz. tender, well done, broiled or roasted beef, veal, lamb, chicken, turkey, or fish, bison, canned tuna fish and salmon*Cheese*—cottage cheese, cream cheese, American cheese used for flavoring*Eggs*—at least one, poached, soft or hard cooked, or scrambled in double boiler*Bread, cereal, cereal products*—4 or more servings—cooked refined enriched cereal, enriched white bread, crackers from refined flour, macaroni, noodles, spaghetti, refined rice*Potato*—one serving white potato, mashed, baked (served without skin), boiled, escalloped, creamed*Vegetable—green leafy*—at least one serving, canned, cooked, or frozen vegetable puree*Vegetable, other*—one or two servings vegetable juice, canned, cooked, or frozen vegetable puree*Fruit citrus*—one serving of strained fruit juice*Fruit other*—one or two servings of strained fruit juice, ripe banana or avocado, canned or cooked fruits without skins or seeds, puréed fruit or dried fruit*Fat*—butter, fortified margarine, cream oils, mayonnaise*Miscellaneous*—gravy, salt vinegar, clear candy, jelly, molasses, sugar, syrup, bouillon, broth, angel food or sponge cake, plain cookies, gelatin desserts, coffee, tea, cereal beverage, carbonated beverage**Omit these foods***Milk*—some omit milk, ice cream, puddings from milk*Meats, poultry, fish*—fresh pork, clams, oysters, fried meat or fish*Cheese*—any cheese other than those listed above*Eggs*—fried*Breads, cereals, and cereal products*—whole grain, bran, crackers and breads made from whole grain flour*Potato*—fried, potato skins, potato chips*Vegetable*—raw whole cooked*Fruit*—raw (other than avocado or banana), canned cooked or dried fruits with skins and seeds*Fat*—meat fats, salad dressings (other than those made from ingredients above)*Miscellaneous*—herbs, spices with residue, nuts, pickles, relishes, olives, jam, marmalade, candy containing fruit or nuts



excluded. Usually, a low residue diet is given for only a few days. It is inadequate in many nutrients, primarily vitamins and minerals.

In reviewing the disorders of the gastrointestinal tract, it is seen that, in general, the principles for preparing the diets described in Chapter 27 cover all the adjustments needed. It is a matter of providing an adequate, well balanced diet of such consistency and composition that it will be nonirritating, low in residue, devoid of high seasonings, and lacking in foods which are rich, gas forming, or slow to digest. The need for vitamins to maintain epithelial integrity is now recognized in combating lesions of the gastrointestinal tract and in the beginning of these diets. This fact must be kept closely in mind.

Wilbur, in discussing the role of the gastrointestinal tract in conditioning deficiency diseases, reminds his readers that the gastrointestinal tract plays an essential role in obtaining and utilizing nutritive substances. Not only the intake but the state of function of the gastrointestinal tract must be considered. There may be diminution or loss of digestive secretions, inadequate absorption of the food nutrients, loss through vomiting, an external fistula or diarrhea, or alterations in metabolism requiring increased needs.

In the treatment of any gastrointestinal disorder, these factors must be borne in mind and treatment adjusted accordingly. Frequently, dietary means are not wholly adequate and commercial products must be used as supplements.

Except where specifically indicated otherwise, from the standpoint of ease of preparation, economy, palatability, and the patient's enjoyment, it is preferable to prepare these diets by modification of the family dietary. If the suggestions given previously are followed, this can readily be done. Specific diet menus are generally unnecessary and should be avoided whenever possible. A further advantage is that the adjusted diet, by conforming to the normal diet pattern is less liable to deficiencies. If the suggestions given are followed, this can readily be done.

In order to ascertain the specific character of a gastrointestinal disturbance, various procedures are used. The test meal (Ewald) is composed of 250 cc of water or weak tea and 1½ ounces of dry toast, taken in the morning on an empty stomach. Samples

of gastric contents are withdrawn at intervals to determine the extent of digestion and the efficiency of the digestive juices. Material may also be withdrawn from the duodenum by use of the duodenal tube. The speed with which food leaves the stomach may be determined by adding to an ordinary meal characteristic substances, such as berries with seeds or tea leaves. Withdrawal of contents at intervals indicates the speed of evacuation.

The time between ingestion and final elimination of food is determined by the ingestion of a "marker," such as carmine, glass beads, or charcoal, and watching for its appearance in the stool.

Bismuth or barium may be added to a milk drink, and its passage may be followed the entire length of the tract by the fluoroscope and x-ray.

Gastrosopes are employed for looking directly into the stomach, the proctoscope for inspecting the rectum, and the sigmoidoscope for examining the sigmoid flexure.

Besides these methods, gross microscopic, and chemical analyses of the feces will determine their normalcy and frequently influence treatment.

### Review Questions

- 1 What general modification of diet is advised in abnormal conditions of the gastrointestinal tract?
- 2 When the tonicity of the stomach muscles is weak, what type of diet may be necessary temporarily?
- 3 What are the outstanding characteristics of the diet used to combat hyperchlorhydria?
- 4 What food adjustments are necessary in cases of hypochlorhydria?
- 5 What are the principles of dietary treatment generally accepted for patients with gastric or duodenal ulcers?
- 6 What are the differences in the diets recommended for acute and chronic gastritis?
- 7 What are some of the causes of constipation?
- 8 What three general types of constipation are recognized?
- 9 What are the principles of dietary treatment in each type?
- 10 What are some of the causes of diarrhea? What are the recognized types of diarrhea?
- 11 What are the principles of treatment in each type of diarrhea?
- 12 What are some of the underlying causes of flatulence?
- 13 What foods are likely to be gas forming for some individuals?
- 14 In addition to the elimination of the offending foods, what else may be done to relieve this condition?

### Suggested Projects

- 1 Plan a diet for a 16 year old girl who has been placed on an ulcerative colitis regimen. Be sure to meet the nutritional demands of this age group. When planning the menu, make allowances for her "social" needs, such as afterschool snacks, and so on.
- 2 Plan a convalescent ulcer diet for a 45 year old man who works in a factory and eats his lunch in the company cafeteria.
- 3 Plan a week's menu for an 8 year old boy who has been suffering with acute diarrhea.
- 4 Plan a diet for an adult man who is both diabetic and has peptic ulcers. Assume his diabetic prescription is protein—70 gm, fat—85 gm, and carbohydrate—200 gm. Keep in mind the specific needs of each condition.
- 5 Plan a day's menu for a 45 year old woman, a homemaker who eats all her meals at home (lunch is eaten alone) who has been placed on a diet for atonic constipation.

## CHAPTER 36

### CELIAC DISEASE

Celiac disease, found almost entirely in children, is a condition in which the patient is unable to absorb carbohydrates and fats. Its etiology is unknown. The primary treatment is the regulation of food. Protein is well tolerated and therefore provides the basis for the dietary regime. The rate and form in which other foods, carbohydrates and fats, are added to the diet differs considerably. However, most restrict both to a varying extent. Limitations in diet are usually necessary for many years.

Several hundred articles have appeared in the literature on the subject of celiac disease but as yet its etiology is unknown. Certain authors contend that tropical sprue, nontropical sprue and celiac disease are identical; others are sure that differences between these conditions exist. Further, debate surrounds the question whether the condition is due to faulty carbohydrate or faulty fat metabolism; whether it is an avitaminosis, an allergy or an endocrine disturbance.

Treatment of course depends largely upon the causative factor or factors which the physician considers dominant. In spite of the uncertainty, the gradual tendency has been toward the generally accepted type of diet outlined later in the chapter. Whatever may be the cause of the disease, this type of diet has proved to be clinically effective.

The disease "sprue" was first described by Ketelaer in 1669. He commented upon the feces "so copious that several basins or pots scarcely held these accumulations." The disease later became known as tropical sprue because it was believed to occur only in the tropics. Throughout medical writings descriptions occur. The classical description was given in 1886 by Samuel Gee who wrote "On the Coeliac Affection." Later, in 1908 Herter published a monograph "On Infantile Chronic Intestinal Infection." More recently, Howland, Hays, Fancourt Parsons, and Thaysen have added materially to our literature on the subject.

The disease is known by a number of titles, intestinal infantilism, Gee's disease, Heubner Herter disease, Gee Thaysen Huebner disease, etc.

There is no information concerning the incidence of celiac disease. It may occur from soon after birth until the fifth year of life. Its appearance is usually gradual, however, when fully developed, among the principal symptoms, present completely or in various combinations is steatorrhea (fatty stools) either with or without diarrhea. The stools are large, frothy,

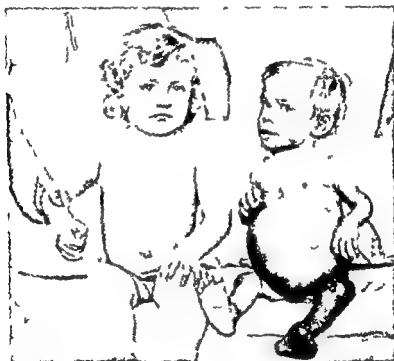


Fig. 68.—These two children are the same age. The obvious difference between the normal (left) child and the celiac child is characteristic of the disease. (Courtesy Dr. Curt Falkenheim.)

foul smelling with a greasy "oatmeal" appearance. Large numbers may be passed in a day. Gastrointestinal disturbances such as abdominal colic and gas, are frequent. The stomach is greatly distended, the buttocks are shrunken and pendulous. The fat stores are completely used up and there is extreme muscular atrophy. Growth is stunted, weight is lost, at times wasting may be marked. The child is introspective, hysterical, and unhappy, a source of misery to himself and to all those around him. In his distressed periods the irritability may become extreme.

Anemia and symptoms of calcium deficiency and avitaminosis appear. Gastric acidity is usually reduced and hypocalcemia is a frequent complication. The occurrence of infantilism suggests endocrine involvement.

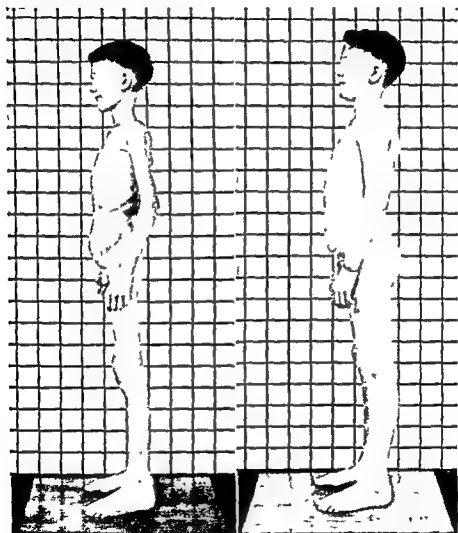


Fig. 69—R. C. at 14 and 16 years of age during a celiac flare up and two years later. The regimen followed during these two years was the diet described in Table 104.

Other conditions possess symptoms similar to those manifested in celiac disease. When diagnosing for celiac disease, it is important that these other conditions be eliminated. One of the most similar is cystic fibrosis of the pancreas. The latter condi-

tion also occurs in early infancy and childhood and it presents a clinical picture which may be identical with that of celiac disease. In addition cystic fibrosis is associated with repeated and persistent upper respiratory infections. There are also further distinguishing characteristics. Has commented that he believed if the patient with cystic fibrosis were treated in the same way as in celiac disease the diarrhea will cease, nutrition become normal and if it has not become too severe the pulmonary infiltration may clear up.

With the fatty stools there is upset in the calcium balance. Calcium is excreted in the feces as calcium soap and there is increased urinary excretion of phosphorus. These combine to bring about abnormal brittleness of the bones due to calcium and phosphorus depletion. Calcium loss has been reported to be so severe as to result in tetany. There seems to be delayed motility and alterations in the small intestine mucosa especially in the jejunum possibly with edema.

These symptoms have led to several theories: first that celiac disease is a specific and perhaps infectious disease of the small intestine which results in multiple nutritional deficiencies; second that it is due to pancreatic or biliary insufficiency; and third that it is a deficiency disease similar to pernicious anemia. The last theory has led to the use of liver extracts, folic acid and vitamin B<sub>12</sub> (see Anemias Chapter 40) with some encouraging results. Another suggestion is that celiac disease is a pituitary dysfunction, a failure on the part of the anterior lobe to produce sufficient prolactin (one of the hormones) to enable the gastrointestinal tract to function normally. Other experience has indicated that an association exists between the celiac syndrome and gastrointestinal allergy and still other research suggests that the intestinal mucosa fails to absorb fats and carbohydrates in a normal fashion.

Recently evidence by Dutch and American research has indicated that celiac patients react unfavorably to the gluten in wheat rather than to its starch content. They further suggested that gliadin might be especially implicated and that rye too might be an allergen. A study in which one of the authors is participating is undertaking to add to these data. In one patient used in a pilot study the improvement on a wheat rye free diet was striking. A group is now under investigation.

Gee in his original discussion first suggested that "To regulate the food is the main part of treatment. If a patient can be cured at all it must be by means of diet." Today, treatment is based on the same idea.

The dietary treatment consists in recognizing the metabolic inability to utilize starch and fats normally. Definite alteration in the ability to absorb these foods occurs. Some place the the major emphasis upon the inability to digest and absorb the starches and others contend that the principal difficulty is with the fat metabolism. Whichever abnormality predominates it is an established fact that both constituents must be adjusted. The normal relationship of protein fat and carbohydrate must be changed. As the condition of the patient improves this relationship may gradually readjust toward the normal.

Harris states one basic principle of the diet in celiac disease which he believes must be established firmly and kept in mind constantly. No food may be ingested by the celiac patient that contains an appreciable amount of carbohydrate other than that found in fruits and to a lesser extent in vegetables and in protein milk. Other clinicians add small amounts of carbohydrate from sources such as cereal.

Protein is well tolerated therefore in the acute stage proteins exclusively are recommended by some clinicians—protein milk, padded, skim milk, calcium caseinate milk, cottage cheese, meats, egg white, gelatin, etc. Harris who has recognized the efficaciousness of banana, adds a completely ripe (brown spotted) banana to this basic diet used in the acute stage. The banana which is of low fiber content may be served raw or baked and from several to a dozen may be tolerated each day. It is imperative that the bananas be ripe! Protein milk is available commercially or there are several methods of preparing protein milk in the home. Three which have been found acceptable are included in Table 103.

When the condition of the patient is improved cooked canned or the juice of fruits are added: apple, apple powder, orange juice and other fruits. These should be added cautiously and singly in order to ascertain if any adverse effects occur. Fruits canned in sugar heavy syrup are usually contraindicated. Vegetables low in carbohydrate value are added next then a limited amount of flaked or puffed cereal or thinly sliced toasted bread.



TABLE 103

## THREE METHODS FOR THE PREPARATION OF PROTEIN MILK\*

**I Protein milk prepared according to Finkelstein and Meyer**

One quart of milk, warmed to temperature of 98° F To this is added one tablespoon of essence of pepsin Allow to drain through cheesecloth for one half hour to separate the whey from the curd The curd mixed with one pint of water is then rubbed through a fine wire strainer several times, and to it one pint of buttermilk is added The whey, which contains most of the sugar, is discarded

**III Protein milk is prepared by Mueller and Kran**

Mix one quart of buttermilk (commercial) and one quart of water and heat to a temperature of 135° F Remove from the stove and let stand for one half hour By this time the curd is well separated from the whey, 36 oz of which should be dipped off The remaining curd and whey are mashed through a fine sieve, and 4 oz of 20% cream or 4 oz from top of bottle milk, and enough water should be added to bring the mixture to 32 oz

**III Powdered protein milk 12 tablespoons of the powder to 32 oz of water**

**IV Calcium caseinate milk** Use from 4 to 6 tablespoons of calcium caseinate (Mead Johnson's Casee) to one pint of water and one pint of milk Mix the Casee with a little cold water (enough to form a smooth paste), pour in the remainder of the cold water Then pour in the milk and bring the whole mixture to a boil while stirring constantly and boil actively for one minute Remove from fire Let cool If necessary to sweeten, use one or two tablets of saccharine (1 gr)

\*Haas S V and Haas M P Cellac Disease Philadelphia and London 1951 J P Lippincott Co pp 198 129

The last addition to the diet is the daily inclusion of an egg yolk It is true that egg yolk is a source of fat, but the fat content is less objectionable than the loss of its valuable constituents of the yolk—vitamins A and D, phosphorus, essential fatty acids, and lecithin The choline which lecithin yields has recently been recognized as a dietary essential When the diet has reached this point in variety, it is as it should remain until some better treatment becomes known

Haas has found that after a week on the basic diet of protein milk, etc, mentioned previously, orange juice, other cheeses including Swiss, cheddar, American and pot cheese, and egg may be added He suggests that these be added one at a time with sufficient interval to test the acceptability of each Then he suggests that after two weeks of this regime all fresh fruits may be tried in the same way Then, when the stools are controlled, vegetables (except potatoes and corn) may be introduced He has found that lettuce, squash, tomato, string beans, and carrots are well

tolerated. It also allows some fat in the dietary management of celiac disease. Fat in association with meats in the normal amount, butter and the fat found in protein milk are allowed. Usually, sour cream can be eaten. He may restrict fats at the beginning but when the celiac child is eating foods other than the basic diet, the foods previously mentioned may be included. It restricts all cereal grains including corn, wheat, rye or rice in any form, whether as bread, cake, toast, zwieback, crackers, cookies, or breakfast cereals. Sugar is forbidden in any form which may include candy, pastries, breads, corn syrup or as a sweetening. However, honey, dates and raisins are permitted. Milk in any form other than protein milk is prohibited. Other clinicians do not restrict the use of cereals and many do not allow fat in the diet.

Recent research from Dutch workers, van de Kamer and Weijers, suggests that olive oil, soybean oil and other unsaturated oils are better tolerated than butter, beef fat and coconut oil in the diet of celiac patients.

In most instances padding must be resorted to by the use of honey on toast, the addition of powdered skim milk to liquid milk, generous use of bananas, malted milk, the addition of gelatin to fruit juices and the like.

Liver should be served once or twice a week. It is a source of vitamin A and of the B complex and is effective in combating anemia from the standpoint of supplying a possible deficiency factor (see Pernicious Anemia, Chapter 40) as well as combating the secondary anemia. Liver preparations administered either by mouth or by injection (Chapter 40) may prove of value.

Commercial sources of the fat soluble vitamins A and D must be given and perhaps also vitamins E and K. The diet of the patient with celiac disease will not yield adequate amounts of the fat soluble vitamins because of the decreased absorptive ability of the intestine. Vitamins and minerals must be above normal because of faulty absorption and symptoms of avitaminosis. Pancreatin and bile salts may be of value in certain cases.

Many clinicians suggest that the diet of the patient must also be low in residue in order not to overstrain the weakened and sagging gastrointestinal tract. To reconcile low carbohydrate vegetables to a low residue diet will require the use of a strainer or

the choosing of those vegetables, or such parts of the vegetable, as would entirely or almost entirely pass through a strainer, as the flowerlets of cauliflower, the tips of asparagus, very tender young carrots, etc. In addition, coarse veins must be removed from leafy vegetables, seeds and skin from fruits, and connective tissue from meat in order to adjust the bulk satisfactorily.

It must be kept in mind that, although the celiac condition may be "under control," so that the patient is eating many more foods than he did when treatment began, he still must be on a restricted diet for a long time, a matter of several years in most cases indefinitely in many. It is possible that a completely unrestricted diet can never be permitted. Control rather than cure might be considered the objective of the diet. The necessary alterations may be made in the diet and a diet should be planned which could be followed indefinitely, or until some as yet unknown factors are found. Such a daily food list which might serve as a guide in planning a maintenance diet is given in Table 104.

It is interesting that in checking over the diet with a large group of celiac patients—known for periods up to twenty years (the Rochester study)—the answers are usually similar. They eat "everything now" and are fine—all cured. However, further questioning usually elicits the information that they dislike fatty foods and frequently add they "never eat pastry and very little bread." They, like the "free" diabetic, have learned to take care of themselves. Further questioning indicates there are bloating, gas, and bouts of cramps. They tire easier, cannot seem to gain weight, are easily discouraged, and frequently are anemic and nervous. As the first patient in the Rochester study said, "I did not know I really didn't feel well 'till I tried the new wheat-rye free diet." May this be the answer we have been looking for? Does the improvement found by some on cereal free diets, the gain on the protein diets, etc., result from the elimination of the wheat and rye proteins? If so, how much more easily the celiac patient of the future will be controlled.

The work of May and his associates deserves consideration, it gives added emphasis to the value of liver extract and supplementary B complex. These authors indicate that there is a decrease in the emptying time of the stomach, a slowing of the segmenting movements and dilation of the small intestine, all of which profoundly influence absorption. Injection of crude

liver extract and of parenteral B complex, on alternate days resulted in improvement of the glucose and vitamin A absorption curves and in the motility of the gastrointestinal tract in from 3 to 6 weeks' time. While they find improvement with this treatment, using the routine diet for the age of the patient, it would seem wiser to follow the celiac type of diet until further data are available. However, emphasis on a higher B complex (containing a natural base) and crude liver extract therapy would seem sensible.

The following dietary program has been found effective at Rochester (University of Rochester Medical Center)

TABLE 104

1 qt skim milk plus powdered skim milk—the amount added should be governed by calories required up to doubling the concentration of the milk—roughly, 1 oz (4 level Tbsp) to 8 oz (1 cup) water results in a “reliquefied” milk

1 whole egg

Two servings { Meat—beef, chicken, lamb, veal, or pork devoid of visible fat  
or  
Fish—light colored (low fat content) only  
or  
Liver—calf, beef, pig, lamb, or chicken

Banana—3 plus, fully ripe (brown spotted) or dried banana products

(1) orange—medium size

Another fruit—apricots, peaches, apples, pears, etc

Vegetables—2 servings—tender carrots, asparagus tips, broccoli, small green beans, squash, spinach (strained), cabbage (hard veins removed), tomato juice and vegetables juices, etc

\* Cereal—1 small serving—corn flakes, grape nut flakes, and other “flaked or puffed” cereals

\* Breads—*melba toast* only—not more than 3 thin well toasted slices

Cottage cheese—skim milk cheese only

Paddings as powdered skim milk, Casein, protein milk, gelatin, or honey

A commercial source of vitamins A and B

Probably a commercial liver product—some of these (Chapter 40, The Anemias) contain the vitamin B complex in addition to liver

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Anderson in her 1947 paper on the "Cholic Syndrome," feels that fat intolerance is transitory and variable—that the in-

ability to handle starch is the more serious phase. In her studies she finds gastric hypoacidity and low pancreatic amylase. She, too, stresses heavy vitamin therapy but uses the oral route.

To repeat, the cause is still not clear, however, dietary adjustment, such as that outlined earlier in the chapter, is effective. By following such a diet outline, a diet high in proteins, vitamins, and minerals will be assured. The diet will be very low in fat and in starches, the carbohydrate being supplied as simple sugars or dextrinized starches, and it will be low in residue and high in anemia preventing foods. Such a diet seems to control the disease and clinically restore to health the individual suffering from celiac disease or a steatorrhea.

### Review Questions

- 1 What are the principal symptoms of celiac disease?
- 2 What theories have been advanced as to the cause of the disease?
- 3 What food nutrients is the celiac unable to absorb? What ones is he able to tolerate?
- 4 What adjustments in diet must be made?
- 5 What are the principles of dietary treatment of celiac disease?
- 6 What food has been found to be especially efficacious in treating such patients?
- 7 What means may be used to furnish sufficient calories in the diet?
- 8 How must vitamin content be assured?
- 9 Is the disease of short or long duration?
- 10 What results may be expected if the diet is rigidly followed?

### Suggested Projects

- 1 Plan a diet for a 3 year old child with celiac disease. Calculate the nutritive content of the diet using Table 133 in the Appendix. What nutrients are below those recommended by the National Research Council? Can the diet be adjusted to remedy this deficiency or must vitamin supplementation be used?
- 2 Plan a diet for a 6 year old child with celiac disease. Include a consideration of such factors as his lunch at school, afterschool snacks and so forth. What difficulties might he have in adhering to the maintenance diet in celiac? How does it compare in nutritive value with the recommendations set forth in Chapter 20?

## CHAPTER 37

### DISEASES OF THE LIVER AND GALL BLADDER

The liver plays such an important role in the normal functioning of the body that whenever diseases of the liver occur, serious complications ensue. In most instances, diet therapy is an important part of the over all treatment. Usually, diets high in protein and carbohydrate and moderate in fat are recommended. In addition liberal amounts of vitamins are desirable. Anorexia on the part of the patient presents difficulties in fulfilling the diet prescription.

**The Liver** Diseases of the liver are considered under disorders of the digestive organs inasmuch as the liver plays such an important role in the digestion and utilization of food. The liver is essential for normal protein metabolism. It stores, resynthesizes into body protein and breaks down the amino acids for combustion and deamination. It is the storehouse for carbohydrates. The liver glycogen serves as a source of dextrose to maintain the blood level constant. The role of the liver in fat metabolism is several sided. It is a storage place for fat and is concerned with the metabolism of fat soluble vitamins A and K. It is further concerned in the normal utilization of fats in that the gall bladder, attached to the liver, acts as a reservoir and stores the bile which the liver has manufactured and pours it into the intestinal tract where its work takes place. As indicated in Chapter 6, bile is necessary for normal fat absorption. The liver also acts as a detoxifying agent when toxic substances are brought into the body in food, are produced by bacterial action, or result from parasitic infections. It also converts worn out red blood cells into bile pigments. If liver cells become sluggish from continued abuse from faulty dietary regime or are injured, various abnormalities result and are followed by disturbances in digestive and metabolic functions.

The diet in liver or hepatic disease necessarily takes account of these conditions. If the liver is well stocked with carbohydrate, it is much more resistant to experimentally produced injuries, and its cells can more rapidly be restored to normal func-

tion than those of a liver whose carbohydrate (and therefore glycogen) content is low. Hepatic injury brings about a lower than normal storage of carbohydrate and, hence, disposes it to further injury. See discussion of liver function in Chapter 6.

Similar to the dietary management in other conditions, the basic principles in the diet in liver disorders are (1) to allow the liver to function as normally as possible, (2) to provide adequate nutrition in order to provide for losses and replacement of injured tissue, and (3) to protect the liver against toxic agents. The dietary schedule described in the following paragraphs may be effective in both acute and chronic liver disorders.

Contrary to former views, the protein content of the diet in liver disorders should be kept relatively high rather than at merely maintenance level. Pollack and Halpern (*Therapeutic Nutrition*, NRC Bulletin No. 234) recommend a daily minimum of 100 gm, whereas others have suggested as high an intake of protein as 110 to 135 gm. The protein apparently has a protective value in addition to its function of promoting tissue repair. Moreover, relatively high protein is of value in combating tendencies to change in serum proteins and hypoproteinemia which may occur in serious liver disease. Wohl\* suggests that the best protein is derived from milk, cottage cheese, egg whites, polished rice, dried yeast, soybean meal, lean meats, and fish. If it is necessary to increase the protein intake, both concentrates and skimmed milk powder are helpful.

At one time fat was rigidly restricted from the diet of patients with liver disorders. However, today, a moderate fat intake is usually recommended. The range is now from 75 to 100 gm of fat. The increase in fats has many advantages, namely, diets are easier to prepare, as many of the foods rich in protein also contain fat; the diet is more palatable, and, by including a higher fat content, the caloric needs are easily met. In addition, fats are carriers of fat-soluble vitamins and essential fatty acids. The emulsified fats, such as egg yolk, cream, and butter, are desirable. The amount of fat used is usually the difference in calories between the sum of the protein and carbohydrate calories and the desired total calories. It must be kept in mind, however, that when the liver does not function normally, fat absorption is incomplete.

\*Wohl. In *Clinical Nutrition*, ed. by Jolliffe. Paul B. Hoeber, Inc. p. 649.

Carbohydrate serves an important function in the dietary treatment of liver disorders. Primarily it will maintain hepatic glycogen stores and thereby exerts a sparing action on protein (see Chapter 6). Pollack and Halpern recommended 400 gm of carbohydrate per day in the diet. These may be supplied in part from sources concentrated in carbohydrate such as sugar, jelly, hard cruds, and honey.

The total calories therefore may be approximately 3000 with roughly 100 gm of protein, 100 gm of fat and 400 gm of carbohydrate. Table 10 contains an illustrative diet which can meet this prescription.

The vitamin intake is important because of the role of the liver in the storage and utilization of vitamins and because interference in bile secretion will decrease the absorption of the fat soluble group. The use of commercial concentrates of vitamins is therefore usually wise. Recent experimental studies indicate that vitamin C has a protective action against liver damage. High vitamin C intake at least is worth consideration.

Liver extracts are beneficial and McLester believes they should always be given a trial. It has been recommended by some that brewer's yeast approximately 25 to 50 gm might be given daily as it is a good source of the B vitamins and amino acids.

Anorexia is a complicating symptom and requires psychic and gustatory incentives to overcome it. Three meals a day, two between meals and a bedtime lunch increase the potential intake with least discomfort. The diet should contain no irritating foods, condiments or alcohol.

To summarize, the diet in liver disease should be high in carbohydrate, have a protein level of a gram to a gram and one half per kilogram of body weight and a moderate fat level. It should have variety and should include a liberal intake of vitamins. It is designed to prevent overwork of the liver cells, to provide optimum protection against further injury and to promote recovery. Under varying conditions the diet may be liquid, soft or a slightly modified normal one.

**Cirrhosis** or hardening of the liver is only slightly amenable to diet treatment, however, if treated in the early stages nutritional therapy may prove beneficial. This disorder brings hypoproteinemia (low blood protein level) which is conducive to ascites (edema). Liberal protein should therefore, be included



in the diet. The response of nutritional edema to vitamin B<sub>1</sub> led to its trial in the liver edema with apparent success. Liver extracts are of value. If only normal amounts of food are eaten with difficulty, commercial vitamins should be administered, especially vitamin K to combat the hemorrhage which frequently occurs in cirrhosis due to lack of this vitamin. Lack of vitamin K may be due to failure of absorption, to a destructive action within the liver itself, or to a decrease of normally functioning liver cells. Bile salts must be administered with the vitamin K unless the product is one of the new water soluble synthetic products having a vitamin K like activity. Choline, cystine and methionine have been tried and found effective in the treatment of fatty and cirrhotic livers. If the patient is suffering from ascites a low sodium diet may be presented. The illustrative diet in Table 105 which is adjusted from the normal diet (Table 74 Chapter 27) is similar to one that might be used in cirrhosis of the liver high in protein and carbohydrate and moderate in fat.

Jaundice, with greenish yellow discoloration of the skin, comes from partial or complete exclusion of bile from the intestinal tract and usually results from an inflammatory condition of the biliary tract. It may also result from toxic destruction of liver cells by certain poisonings: chloroform, yellow fever, phosphorus poisoning etc. A third type of jaundice occurs, hemolytic jaundice from destruction of red blood cells and break down of their hemoglobin into bilirubin a bile pigment. Jaundice means yellow, and in this disease the bile pigments stain both the eyeballs and the skin. As indicated above, jaundice is a symptom of many possible disorders involving the liver and biliary tract.

Diet in jaundice should be a simple nonstimulating, soft low fiber diet consisting chiefly of milk, cereals toast, and potatoes for the first ten days. After that time tender meat, eggs, cooked fruit and simple desserts—custards, gelatin, rice, etc.—may be added as clinical conditions permit.

Infectious hepatitis is believed to be the same condition that used to be known as *catarrhal jaundice*. Its etiology is not definitely known but it is thought that its cause is due to a filtrable virus. During World War II the incidence of infectious hepatitis

TABLE 105

## ILLUSTRATIVE DIET IN LIVER DISORDERS

**Include these foods each day**

- Milk*—1 pint to 1 quart milk or milk drinks  
*Meats, poultry, or fish*—6 to 8 oz lean meats, fish or poultry (except those listed below)  
*Cheese*—cottage, farmer, skim milk cheeses; other cheese in moderation  
*Eggs*—1 or 2, poached, soft or hard cooked, or scrambled in a double boiler  
*Bread, cereal, cereal products*—4 or more servings—whole grain or enriched bread or cereal, rice, spaghetti, noodles, and macaroni  
*Potato*—1 serving or more (except those listed below)  
*Vegetable, green leafy*—at least one serving  
*Vegetable, other*—one or more servings  
*Fruit, citrus*—at least one serving, as fruit juice or fruit  
*Fruit, other*—one or more servings, as fruit juice or fruit  
*Fat*—limited amounts (will vary), butter, fortified margarine, vegetable oils, shortening 20% cream  
*Miscellaneous*—tea, coffee, cereal beverages, carbonated beverages, gelatin desserts, ice cream, puddings, cakes, cookies custards in moderation, sherbets, clear candy, candy made with fruit, sugar, syrups, jams, jellies, herbs, salt, pickles, relishes, vinegar, spices in moderation, gravy (if skimmed)

**Omit these foods**

- Meats, poultry, fish*—fatty meats, fish, or fowl, fried meats, fish, or fowl  
*Cheeses*—(see above)  
*Eggs*—fried  
*Bread, cereal, cereal products*—no restrictions  
*Potato*—fried or potato chips  
*Vegetable*—no restrictions  
*Fruit*—avocado, olives  
*Fat*—heavy cream, meat fats  
*Miscellaneous*—desserts high in fat (pastries, some puddings), nuts, candy made with nuts, rich chocolate candy

increased. Its transmission is not known, though some epidemics have been recognized as being due to water, some foods, and milk.

The chief symptoms of infectious hepatitis are jaundice and enlargement of the liver. Others which also occur frequently may be the clinical indications of infection, gastrointestinal disturbances, and nutritional deficiency states. Capps and Barker suggest that the basis of treatment lies in bed rest and diet therapy. In addition, the patient should avoid all other factors that might injure the liver further. They suggest a high protein, high carbohydrate, and moderate fat diet, this might be distributed as 200 gm of protein, 300 gm of carbohydrate, and 65 gm of fat. Others have suggested a diet regime similar to

the one outlined in Table 105. Although the patient may recover from the acute stage of infectious hepatitis, he usually must remain on the diet mentioned above for several months at least. Many individuals, even though apparently cured of symptoms, find it necessary to be cautious in their use of fatty foods, alcohol, and condiments lest the condition recur.

The gall bladder correlates the secretory activity of the liver with the activity of the gastrointestinal tract. It stores the bile elaborated by liver cells and releases it to the intestine by hormonal or psychic stimulus. Cholelithiasis (stone formation) or cholecystitis (inflammation) may interfere with the normal function of the gall bladder, and one disorder seems to bring about the other, although which is the cause and which the effect is questionable. The predisposing causes are biliary stasis, with stagnation of the bile, increase in concentration, and deposition of insoluble matter. Infection may involve the gall bladder and the bile.

There may be disturbance in bile pigment excretion, and small pigment calcium stones are formed in certain cases of jaundice. Upset of the normal cholesterol metabolism may result in the formation of gallstones, waxy and glistening, varying in size from a grain of sand to a small hen's egg, and from one to several hundred in number (94% of all gallstones contain cholesterol). Stone formation may take place at any age, but it occurs most frequently in women between 30 and 50 years, particularly in the "fair, fat, and forty." There is no evidence that there is a relationship between cholesterol in the diet and cholesterol (cholesterol) in the bile. It will be remembered that endogenous synthesis of cholesterol occurs even on a low cholesterol diet. Roughly, 2 gm of cholesterol are produced endogenously each day.

The attack of gallstones or inflammation of the gall bladder is much like "indigestion" with loss of appetite, gas, sour taste in the mouth, nausea, constipation or diarrhea, sharp pain, fever and chills. Intolerance for fat may be present.

The dietary treatment is based on three factors: association between hypercholesteremia and gallstone (biliary calculi) formation, normal stimulating action of fat upon the emptying time of the gall bladder, and the frequent coexistence of hepatic

tis. These conflicting factors lead to complication in diet planning and malnutrition may be a further element of confusion. Diets low in fat low in cholesterol, and either high or low in calories may be used or diets relatively high in fat and cholesterol with calorie adjustment may be preferred. In any case the protein is relatively high, 80 to 120 gm, since protein as well as fat has a stimulating effect on gall bladder evacuation. Carbohydrate will supply the remainder of the calories which must be low enough to avoid weight gain, since obesity and overeating are undesirable. When blood cholesterol is high, foods rich in cholesterol (eggs butter, cream and glandular meats) should be excluded (see table of cholesterol containing foods in Chapter 39). As Twiss and Greene point out the cholesterol values

TABLE 106

## ILLUSTRATIVE DIET FOR SOME DISORDERS OF THE GALL BLADDER

**Include these foods each day**

Milk—1 pint or more

Meats poultry or fish—4 oz lean meats fish or poultry (except those listed below)

Cheese—cottage cheese cheddar cheese used as flavoring if tolerated

Eggs—one poached soft or hard cooked or scrambled in a double boiler

Bread cereal cereal products—4 or more servings—whole grain or enriched bread or cereal rice spaghetti noodles and macaroni

Potato—1 serving or more (except those listed below)

Vegetable green leafy—at least one serving (except those listed below)

Vegetable other—one or more servings (except those listed below)

Fruit citrus—at least one serving as fruit juice or fruit

Fruit other—at least one serving as fruit juice or fruit (except those listed below)

Fat—limited amounts (will vary)—butter fortified margarine 20% cream vegetable oils shortening

Miscellaneous—coffee tea carbonated beverages cereal beverages gelatin desserts ice cream puddings cakes cookies custard in moderation angel food cake sherbets clear candy candy made with fruit sugar syrups jams jellies liches pickles relishes vinegar spices in moderation gravy (if skimmed)

**Omit these foods**

Meats poultry fish—fatty or fried meats

Cheeses—all not listed above

Eggs fried

Breads cereal cereal products—in restriction

Potato—fried or potato chips

Vegetable—gas forming vegetables such as cauliflower rutabaga green peppers dried fruit such as prunes and cumbers radishes turnips

Fruit—avocado raw apples

Fat—heavy cream

Miscellaneous—desserts high in fat (pastries some puddings), nuts candy made with nuts rich chocolate candy

available leave much to be desired. There is need for greater accuracy in distinguishing between the types of sterols present in foods. However, this is the best list available at present.

When the gall bladder is sluggish and neither fat intolerance nor hypercholesteremia, nor stones exist, a high fat cholesterol intake is of value. These substances stimulate the formation of cholecystokinin, a hormone which Ivy and his co-workers have shown to produce gall bladder contractions. Therefore, the diet should contain a generous amount of protein and should be high or low in fat depending upon the type of gall bladder dysfunction. The diet should be adjusted calorically to the nutritional need with carbohydrate. The vitamin intake may need supplementation depending upon fat intake and absorption, and the amount of liver involvement. Minerals should be adequate. The diet should be nonirritating and should contain only easily digested foods. The bulk should be adjusted to the condition of the rest of the intestinal tract. A "lazy" colon is frequently associated with gall bladder diseases (see Constipation, Chapter 30). Smaller and more frequent meals are preferred when cholecystitis and other gastrointestinal disturbances exist. Hypoacidity or hyperacidity may require consideration. Frequently, a diet which is restricted in fat to approximately 40 gm is prescribed. An illustrative diet meeting that prescription and adjusted from the normal diet (Table 74 Chapter 27) is included in Table 106. The diet may be further restricted as to the kind and distribution of its fat content.

### Review Questions

- 1 What important functions does the liver perform in the digestion and utilization of food?
- 2 Approximately how much protein per kilogram of body weight should a diet in liver disease contain?
- 3 How should the carbohydrate and fat in the diet be distributed?
- 4 What other factors should be considered in planning a diet for a patient with liver disease?
- 5 What is the role of vitamins in diseases of the liver?
- 6 What is the function of the gall bladder?
- 7 What difficulties may interfere with its normal functioning?
- 8 What are the symptoms of inflammation of the gall bladder?
- 9 What types of diet may be helpful in treating a patient with gall bladder difficulties?

### Suggested Projects

- 1 Plan a diet for a patient, a 19 year old man, with infectious hepatitis. What are the difficulties you encountered in meeting the diet prescription? What foods can you include in the menu that may overcome his possible anorexia?
- 2 Plan a diet for a patient, a 45 year old woman, who has been placed on a restricted fat regime. She is working and eats her lunch away from home. What are the problems that she might meet in adhering to the diet? How may they be solved?
- 3 Adjust your own menus to the one suggested in the preceding pages for restriction of fat. Which foods would you have to eliminate from your diet? Would it be difficult for you to do so? Are they foods that you particularly like or would you not object to omitting them from your menus?

## CHAPTER 38

### DISEASES OF THE KIDNEY

Disorders of the kidney range from acute and chronic infections to degeneration of the nephrons and metabolic disturbances of salts. Most conditions require adjustments of one or more elements in the diet. Chief among the modifications are protein, sodium, and fluid. In some instances, it is necessary to restrict foods rich in organic salts or to choose foods that will render the urine either acid or base. The extent of adjustment is governed by the disease and clinical condition of the patient.

In order to understand the dietary treatment effective in diseases of the urinary tract, a summary of the kidneys and their functions is in order. A brief review of kidney function is presented in Chapter 15. It will be remembered that the kidney excretes waste products in the urine, plays a major role in the regulation of the acid base balance of the body, and maintains normal composition of the blood. Between 1 and 2 liters of urine are normally excreted daily. The kidney is indeed one of the vital organs which, when functioning normally, maintains the body in a state of health.

#### Nephritis

Nephritis or Bright's disease is a general term used to designate altered kidney function due either to inflammatory process or to degenerative change. The classical description of the general condition was given by Richard Bright (1789-1858) in 1827. He described the dropsy, albuminous urine, and other related pathological conditions seen in this disease. Since then the terms Bright's disease and nephritis have been synonymous. Attempts have been made to classify or to differentiate the types by indicating the location or type of lesion, such as glomerulonephritis, nephrosclerosis, etc. The nephritic condition may be subacute, acute, or chronic and it may be complicated by edema, uremia, hypertension, and gastrointestinal disturbances.

**Glomerular nephritis** (acute hemorrhagic nephritis) is an *inflammatory* disease that affects the glomeruli. It has an acute

onset with hematuria in varying degrees, proteinuria, edema, hypertension and usually nitrogen retention. It may exist in the acute, latent or chronic stage. McLester points out that one of the hazards of the disease is the fact that it may subside into a latent stage which results in false security since it may last for years only to flare up again. The condition often follows streptococcus infection as an aftermath of tonsillitis or scarlet fever by invasion of the infecting organism into the kidneys. It is essentially a disease of youth. Segal and his associates in their study found that 50% of the patients were under 10 years of age and 70% were under 20 years.

The diet in the acute stage which is frequently accompanied by nausea and vomiting is usually limited to carbohydrate padded fruit juices. From this the patient progresses to the milk diet and a gradual change to low sodium soft diet which at the end of ten days may gradually approximate the normal diet. The Kirell diet so frequently used in acute nephritis is an entirely milk diet. It consists of 800 cc of milk given as four feedings of 200 cc each. It provides 550 calories, 26 gm of protein, 40 gm of carbohydrate, 32 gm of fat, 1.6 gm of sodium chloride and approximately 800 cc of water.

The total fluid intake unless edema is present should be adequate to render the dissolving of the urinary solids easy. If edema is present liquids must be restricted to from 800 to 1,000 cc and sodium chloride to about 3 gm or less. Sodium restriction is necessary only when edema is present. See Table 106 for sodium content of foods.

As quickly as possible the protein intake should again reach the level of approximately 1 gm per kilogram of body weight (for the adult 10% of the desired calorie intake) in order that the body protein stores may be protected. Duncanson believes that most patients will have progressed to a full diet with the possible exception of the sodium content by the end of the second week.

In acute nephritis then the diet is directed toward the immediate relief of the kidney while requirement of normal balance of food constituents being ignored inasmuch as the condition is of short duration. However as soon as possible the diet should be restored to normal levels.



When the condition becomes **chronic**, the nutrition of the patient is an important consideration. Harrop believes that from the dietary standpoint, chronic nephritis is a wasting disease and that maintenance of nitrogen equilibrium is essential. The dietary calculation, therefore, should be based on preferred body weight rather than on actual weight. The nutritional condition of the patient is important, and, since adjustment is made necessary by the deranged kidney function, compensatory provision must be made to prevent a deficiency from occurring. If obesity is not a factor, the normal caloric intake should be allowed. If the caloric intake is below requirement, protein will be utilized for energy purposes unless fat stores are available. This is undesirable.

In years past, drastic protein restriction was practiced. This led to protein deficiency which was harmful. Protein must meet the normal needs and it must also replace the albumin lost in the urine—from 1 to 15 gm. of protein per kilogram of body weight. Thus, from 75 to 100 gm. of protein are needed daily and some clinicians recommended 150 gm. In determining the diet prescription for children, the protein should supply approximately 15% of the desired calories (see Chapter 20) at the normal level.

If there is interference with the normal exchange of fluid between blood and tissue spaces, and the fluid in the tissue spaces is abnormally high, a condition known as edema (oedema) exists. This may be brought about by several conditions. A low serum protein level in the blood results in a nephrotic edema, when the blood protein falls below 4%, edema nearly always appears. An increase in capillary wall permeability—nephritic edema—and an increase in pressure within the capillaries, caused in part by an increase in venous pressure which results from impaired heart action, produce a cardiac edema. Edema may also result from failure of the body to dispose of salt normally, and from nutritional deficiencies—deficiency edema or war edema.

The relationship between sodium and edema plays a role in many diseases (see Chapter 13). Drastic restriction of sodium may be extremely detrimental and excess amount may likewise be detrimental, hence the logical plan is to meet normal daily need even though theoretically very low intake may be desired. If edema is present, restriction of sodium intake to maintenance

level is indicated. This can be accomplished by the simple expedient of using only moderate amounts of sodium chloride in cooking, adding no extra salt at the table and by omitting all salted foods. These precautions will reduce salt intake to approximately 3 gm. which is a minimum intake. Some clinicians recommend that the patient soak meat and vegetables for approximately twenty-four hours to remove sodium. This can result in a highly unpalatable diet deficient in other essential minerals. In addition, such a diet can produce anorexia in the patient.

Newburg suggests that an acid ash diet is effective in reducing edema through withdrawal of sodium from the tissues. Sansum, on the other hand, feels that an acid ash diet renders the work of the kidneys more difficult and for this reason prefers a predominantly basic diet. The general consensus is that a slightly alkaline ash is optimum (as in normal diet) except where specific alteration is needed to combat stone formation or infection (see following discussion on urolithiasis).

Anemia is frequently a complication and foods rich in iron or in substances essential to blood regeneration should be planned. However, it has been reported that such anemia is not improved by liver or iron therapy and that in many cases long periods of diet restriction may have been a contributing factor.

Uremia appears when function impairment is so acute that accumulation of waste products takes place in the body due to renal insufficiency (inability to excrete waste products). When this occurs radical adjustment is again necessary. True uremia is characterized by depression, drowsiness and lethargy and finally coma. Headache, nausea and vomiting further complicate the condition. There is retention of urine and acidosis. Protein therefore must be reduced to a low level and acidosis must be combated by the use of sugar-padded fruit juices. High fluid intake, unless circulatory disturbances contraindicate, should be the rule.

### Nephrosis

Nephrosis is a degenerative type of Bright's disease rather than an inflammatory process in which the changes are confined to the tubules. Nephrosis is insidious in its onset and usually

follows an infection or an intoxication. It is characterized by profuse albuminuria, low serum proteins, edema, lowered basal metabolic rate, and anemia. Hypertension and urine retention are not characteristics of this condition. Nephrosis may occur as a stage in the course of some cases of chronic glomerulonephritis.

The symptoms of the disease indicate the dietary treatment. High protein intake, up to 2 or 3 gm per kilogram of body weight (20 to 30% of calories), i.e., normal requirement plus the amount lost in the urine, increase in carbohydrate level, and sodium restriction, characterize the diet plan. At times there may be a high fat and cholesterol level in the blood, lipoid nephrosis. If this occurs, dietary fat must be restricted. It is believed by some that lipoid nephrosis is not a true kidney disease but is due to general metabolic disturbance.

### Nephrosclerosis

Involvement of the circulating system, as well as reduction of renal function, results in nephrosclerosis, or arteriosclerotic Bright's disease. It is a vascular disease, which in its latter stages is accompanied by impairment of the kidneys. The symptoms include arterial hypertension, cardiac hypertrophy, some proteinuria, vague digestive disorders, and headache. Later, as the condition advances, the heart becomes greatly enlarged, and symptoms of myocardial incompetency appear. Finally, nitrogen retention and eye (retinal) changes become manifest. At the end of a long course death usually results, from circulatory failure rather than from renal insufficiency. The diet adjustment consists of an adequate diet of simple foods as suggested in Chapter 27. This diet is free from highly spiced and rich foods that may result in digestive upsets. Salt should not be excessive, but reduction is not necessary.

To summarize the dietary adjustments in the several types of renal disease, the following points must be kept in mind. When nitrogen retention is excessive the protein level must be reduced. When there is neither retention nor proteinuria the level should be that of the normal diet but when albuminuria is present, the protein must be increased as compensation.

When edema occurs sodium intake should be reduced. At other times there is no need for restriction. When edema or

cardiac insufficiency is present, limitation of water is necessary. If these are absent, the intake of water may be governed by thirst.

TABLE 107

## ILLUSTRATIVE 40 GRAM PROTEIN DIET

FOOD	AMOUNT
Milk, whole	1 cup
Meat, poultry, fish	2 oz
Bread, cereal, cereal products, whole grain or enriched	4 servings
Potato, cooked	1 small
Vegetable, green, leafy	1 serving
Vegetable, other	2 servings
Fruit, citrus	1 serving
Fruit, other	2 servings
Butter or fortified margarine, oils	As desired

Adapted from Basic Diet (Table 74). This diet plan is lower than the Recommended Allowance for a 25-year-old woman in protein, calcium, iron, thiamine, riboflavin, and niacin.

In the presence of high blood fat and blood cholesterol, the fat intake should be limited to a low level. Otherwise the diet should be adequate as to calories except in acute stages or where weight loss is desired. The diet should have a somewhat higher than usual level of carbohydrate. It should meet the normal need for vitamins, be free of high spicing or condiments or any constituent which may be irritating. The diet should be adjusted (unless contraindicated) to leave a neutral or slightly alkaline ash. A diet high in protein may be found in Chapter 27. The details of a diet restricted in sodium are given in Chapter 39. An illustrative diet which is low in protein is included in Table 107.

## Urinary Tract Infections

Pyelitis, inflammation of the pelvis of the kidney, or pyelonephrosis and cystitis, inflammation of the bladder, are all infections of the urinary tract. Treatment is directed toward the elimination of the infecting organisms. Forcing fluids and alteration in urinary pH are of value. These may be brought about by adjustment in acid-base balance and by the use of the ketogenic diet, which is also acid ash. This diet, as pointed out under Epilepsy, Chapter 32, is difficult to follow.

Recently the sulfa drugs, sulfanilamide, sulfapyridine, etc., and mandelic acid have largely superseded dietary adjustment, although there is greater effectiveness when dietary adjustment

is also made. This is especially true when mandelic acid is administered. The object is to increase the acidity of the urine to the point that infecting organisms cannot grow. An acidity of approximately pH 5.2 (5.5 to 5.0) seems effective.

### Supersaturation of Urine

Under the influence of the colloids of the urine, greater concentration of salts is possible than in a simple water solution. When there is interference with this physiochemical equilibrium precipitation of salts can occur, but this is not a disease condition. It is a metabolic disturbance. A number of salts may be so affected.

Phosphaturia occurs when phosphate crystals are thrown out of solution. This results in a milky, cloudy urine and frequently occurs in nervous tension or nervous upsets. Treatment consists in quieting the nerves, the ingestion of an acid ash diet to favor phosphate solution and a diet low in calcium, which also tends to increase the solubility of the phosphorus. The diet naturally should be low in phosphorus. Calcium poor foods, such as meat and cereals, should replace milk, eggs, and green vegetables so far as possible, without interfering with adequate nutrition.

Oxaluria indicates that calcium oxalate crystals are being precipitated. This may take place in either an acid or an alkaline urine. Foods rich in oxalates: spinach, beans, tomatoes, figs, strawberries, potatoes, plums, cocoa, chocolate, and tea should be avoided. Bread, muscle and glandular meats contain some oxalate and should, therefore, be eaten in moderation. Foods containing little or no oxalic acid, such as dairy products, fats, rice, peas, cabbage, asparagus, mushrooms, apricots, grapes, and melons, should form the greater part of the diet (see Appendix for oxalic acid content of foods).

Urates, when deposited, result in a condition known as uraturia. The precipitation takes place in acid urine. The rendering of the urine alkaline and a decrease in uric acid (purine) intake are effective in controlling the condition. The elimination of uric acid requires omission of all glandular meats, whole grain cereals, certain vegetables, etc. (see Gout).

Cystinuria, as the name implies, is a deposition of cystine. Under ordinary circumstances, cystine is destroyed and appears

only in minute traces in the urine. In such conditions the urine should be rendered alkaline and sulfur rich foods should be curtailed. Milk should be the chief source of protein since it is high in biological value and low in sulfur. Eggs may be used in moderation. Meats should not be used at all. Occasionally the metabolic disturbance may be such that other amino acids may also appear in the urine.

Alkaptonuria is a disease in which the intermediary metabolism of protein in the liver is disturbed. The urine becomes dark upon standing due to the presence of homogentisic acid which is derived from the amino acids tyrosine and phenylalanine. Therefore these acids must be restricted. Proteins in general should be reduced to maintenance level. Milk, cheese and cream are important sources of tyrosine and should therefore be restricted.

### Renal Calculi (Urolithiasis)

When excessive precipitation of urates, oxalates or phosphates occurs, stones may be formed in the kidney. These are usually combinations of all three salts but with one salt predominating. Infection and deficiency of vitamin A are probably causative. Symptoms of vitamin A deficiency can usually be shown to coexist with stone formation. The dietary treatment will depend on the type of stone and the associated symptoms. Dietary changes suggested for oxaluria, phosphaturia etc. are applicable to stones as well. The pH adjustment may be dietary and chemotherapeutic. High vitamin A intake is important here as in all infections of the urinary tract. Dietary history frequently will show that fat restriction has existed which means that vitamin A inadequacy has permitted changes in the epithelial tissue lining the urinary tract. Inadequacy of vitamins C and B also predispose to infection. Too high carbohydrate intake and prolonged use of mineral water, endocrine disturbance and kidney malformation are all contributory causes of this condition.

Cystinuria and alkaptonuria are somewhat hereditary in occurrence. This is not true of other types of stones. While stones may occur at any age, about 50% appear between 30 and 50 years of age and slightly more often in the male. There may be countless small stones the size of a pin point, or large stones even as large as an orange.

TABLE 108

## EXCESS OF ACID FORMING OR BASE FORMING ELEMENTS

ARTICLE OF FOOD	EXCESS ACID OR BASE IN TERMS OF NORMAL SOLUTIONS			
	PER 100 GRAMS		PER 100 CALORIES	
	ACID (C C)	BASE (C C)	ACID (C C)	BASE (C C)
Almonds		12 38		1 86
Almonds		11 76		1 76
*Apples		3 76		5 98
Asparagus		0 81		3 65
Bananas		5 56		5 62
Beans, dried		23 87		0 92
Beans, dried		11 58		3 36
Beans, Lima, dried		41 65		12 08
Beets		10 86		23 57
Cabbage		4 34		18 76
Cabbage		7 10		22 51
Carrots		10 82		23 91
Cauliflower		5 33		17 48
Celery		7 78		12 17
Cherry juice		4 40		
Chestnuts		7 42		3 19
Corn, sweet, dried	5 95		1 77	
Crackers	7 81		1 95	
Currants, dried		5 97		1 85
Eel	9 89			
Eggs	11 10		7 55	
Egg white	5 24		9 52	
Egg yolk	26 69		7 08	
Fish, haddock	16 07			
Fish, pike	11 81			
Lemons		5 45		12 32
Lettuce		7 37		38 69
Meat, beef, lean I	13 91		12 10	
beef, lean II	10 05		8 74	
beef, lean	12 00		10 44	
beef, lean	18 67		11 89	
chicken	17 01			
frog	10 36			
pork, lean	11 87			
rabbit	14 80			
veal	13 52			
venison	15 83			
Milk, cow's		2 37		3 44
Milk, cow's		1 26		1 83
*Muskmelon		7 47		18 82
Oatmeal	12 93		3 23	
Oatmeal	10 63		5 66	
*Oranges		5 61		10 94
Peaches		5 04		12 20
Peanuts	3 9		0 70	
Peas, dried		7 07		1 98
Peas, dried		3 36		0 94
*Potatoes I		7 19		8 63
*Potatoes II		5 5		

TABLE 108—CONT'D

ARTICLE OF FOOD	EXCESS ACID OR BASE IN TERMS OF NORMAL SOLUTIONS			
	PER 100 GRAMS		PER 100 CALORIES	
	ACID (C C)	BASE (C C)	ACID (C C)	BASE (C C)
Potatoes		77		9.6
Prunes		24.40		8.05
Prunes		55.55		8.43
Radishes		2.97		9.79
*Raisins		27.69		6.97
Raspberry juice		191		
Rice I	81		3.35	
Rice II	7.08		2.05	
Rice	8.75		2.42	
Turnips		2.68		6.86
Turnips		6.80		9.41
Wheat, entire	9.66		3.25	
Wheat, entire	12.39		3.47	
Wheat, flour	11.61		2.70	

\*Have been found experimentally by Hattlerwick to be particularly effective in reducing the acidity of the urine.

Refr. lucid. fr. in Sherman and Cottler J. Biol. Chem. 11 373 1912  
 Courtesy of Dr. Sherman and the Journal. Dr. Sherman in granting permission writes: In using these figures it should be quite clear that they are arrived at by calculations from the analyses which calculations involve assumptions, so that the figures should be taken only as general guides. These figures are however of value in adjusting urinary pH by means of diet.

The presence of a stone brings on vague discomfort in the region just under the ribs in the back and about 2 inches from the spinal column. This is accompanied by tenderness and a disinclination to move. Sudden sharp knifelike pains, radiating down around the lower part of the abdomen may occur. Urine is scanty, but the desire to urinate is frequent. Blood may be present in the urine as the result of trauma to the ureter from the stone. When the stone has passed into the bladder, the pain ceases. Inasmuch as the stones may form at intervals all possible dietary adjustment should be made and continued as preventive measures. While dietary adjustment does not always bring about the desired results a liberal water intake, elimination of possible causative food factors, increased intake of vitamins A, B, and C, elimination of foci of infection, and avoidance of infections, in addition to observance of the general rules for good health and hygiene should be included as part of the treatment.

The benefit derived from either an alkaline ash or an acid ash diet in renal calculi is a subject of controversy. Table 108 lists foods which contain excess acid forming and base forming ele



TABLE 109

## FOODS INCLUDED AND EXCLUDED IN HIGH ACID ASH DIET FOR BASIC URINARY CALCULI

TYPE OF FOOD	FOODS INCLUDED	FOODS EXCLUDED
Beverage	Cereal beverage, coffee, milk not more than 1 pint daily, tea	Carbonated beverage
Bread	Any, with emphasis on whole grain or enriched bread, except those listed under "Foods Excluded," at least 6 slices daily, crackers, rolls	Boston brown bread, pumpernickel, Rusk
Cereal	Any, with emphasis on whole grain or enriched, at least 1 serving daily	None
Dessert	Cakes and cookies, except those listed under "Foods Excluded," cream or custard pie, cranberry, plum or prune desserts, custards, plain ice cream, plain cereal puddings	Cornstarch pudding, desserts made with fruit other than cranberries, plums or prunes, gelatin desserts, gingerbread, molasses cookies
Fat	Butter, cream, not more than $\frac{1}{2}$ cup daily, fortified margarine, salted dressing, salad oil, shortening	None in amounts allowed
Fruit	Cranberries, plums, prunes, not more than 1 serving daily of other allowed fruits	Dried fruits except prunes, bananas, rhubarb
Meat, egg or cheese	Any meat, fish or fowl, including 1 egg and at least 2 servings of meat or substitute daily, any cheese except those listed under "Foods Excluded"	Gruyere cheese, Parmesan cheese
Potato or substitute	Corn, hominy, lentils, macaroni, noodles, rice, spaghetti, 2 servings daily	Potato
Soup	From foods allowed, broth	Soup from dried beans or peas
Sweets	Cranberry or plum jelly, sugar, peanut brittle, plain sugar candy	Other candy, honey, other jam, jelly or marmalade, molasses, syrups
Vegetable	2 servings daily as allowed	Dried beans, beet greens, dandelion greens, carrots, chard, endive, kale, kohlrabi, Lima beans, spinach
Miscellaneous	Brazil nuts, filberts, gravy, peanut butter, peanuts, popcorn, salt, spices, walnuts	Other nuts, olives, pickles, vinegar, white sauce

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TABLE 110

FOODS INCLUDED AND EXCLUDED IN HIGH ALKALI ASH DIET FOR ACID URINARY CALCULI

TYPE OF FOOD	FOODS INCLUDED	FOODS EXCLUDED
Beverage	Carbonated beverage, cereal beverage, coffee, milk, at least 1 pint daily, tea	None
Bread	Any, with emphasis on whole grain or enriched, not more than 3 slices daily, crackers if substituted for bread, rolls	None in amount allowed
Cereal	Any, with emphasis on whole grain or enriched not more than 1 cup daily	None in amount allowed
Dessert	Cakes and cookies containing permitted fruit or nuts, cornstarch pudding, desserts made from permitted fruits, gelatin desserts, plum ice cream, milk desserts	Plain cakes and cookies, plain cereal puddings, cranberry, plum, or prune desserts, custards
Fat	Butter, cream, fortified margarine, salad dressing, salad oil, shortening	None
Fruit	Citrus fruit or juice and at least 3 servings of other fruit daily with emphasis on dried fruits except prunes	Cranberries, plums, prunes
Meat, egg or cheese	Any meat, fish, fowl or cheese but not more than 1 egg and 4 ounces of meat or substitute daily	None in amounts allowed
Potato or substitute	Potato at least once daily	Hominy, macaroni, noodles, rice, spaghetti
Soup	Any except those containing barley, flour, noodles, rice or spaghetti	Thickened cream soups, soups with barley, noodles, rice or spaghetti
Sweets	Candy, honey, jam, jelly and mar-malade except those listed under "Foods Excluded," molasses, sugar, syrups	Cranberry or plum jelly
Vegetable	At least 4 servings daily	Corn, lentils
Miscellaneous	Almonds, chestnuts, coconut oil, pies, pickles, salt, spices, vinegar	Flour, gravy, all nuts except those listed in "Foods Included," peanuts, popcorn, white sauce

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ments. In some cases daily menus are calculated for the patient from tables such as these. Others prepare diets which will produce either excess acid or base in the urine, and from these diets the daily menus are planned. Tables 109 and 110 illustrate such diets.

### Review Questions

- 1 What diet is often prescribed for a patient with acute nephritis? What constitutes the diet and what are the underlying principles?
- 2 If the diet is not well tolerated, how else may nourishment be given?
- 3 What should be the fluid and sodium intake in the diet for acute nephritis?
- 4 What are the factors that govern the protein intake in chronic nephritis? Explain
- 5 What is the importance of calories in chronic nephritis?
- 6 What dietary measures must be instituted if uremia appears?
- 7 What is the diet plan in nephrosis? Nephrosclerosis?
- 8 What dietary adjustments may be effective in causes of pyelitis and cystitis?
- 9 Precipitation of various salts in the urine may occur. What food restrictions should be made in the following: phosphaturia? oxaluria? uraturia? cystinuria? alkaptonuria?
- 10 If there is excessive precipitation and kidney stones are formed, what are the dietary indications?
- 11 What role does vitamin A play in these conditions? Vitamins C and B?

### Suggested Projects

- 1 Plan a day's menu for a 12 year old boy with chronic nephritis. Did you have any difficulty in planning foods that would be appetizing to him? Does your menu meet the nutritional needs of a boy that age?
- 2 Plan a day's menu for a 10 year old girl with nephrosis. What are the foods that children particularly enjoy that you had to omit from this diet? What foods were you able to include that are appealing to children? Do you think that a child suffering from anorexia would consume a diet similar to the one you planned? What can you do to encourage her to eat?
- 3 Plan a day's menu which meets the nutritional needs of a 45 year old man who has been placed on an acid ash diet for renal calculi. It is necessary for him to eat his lunch at a lunch counter. What difficulties would he encounter in following his diet while he is away from home? What adjustments could he make so that he will be able to go out socially once or twice a week?

## CHAPTER 39

### CIRCULATORY DISTURBANCES

Cardiovascular diseases are responsible for 600 000 deaths per year in the United States. Dietary modification is used extensively in the treatment of the different disorders. Reduction in body weight may be the initial consideration. As the causes for the various heart conditions are unknown the diet is planned to bring about a symptomatic relief. The diet may be modified in caloric fat cholesterol and sodium content as well as limited to specific foods depending on the particular disorder and the condition of the patient.

Diseases of the kidney and diseases of the circulatory system are so intimately connected that one cannot be discussed without reference to the other. Malfunction of either soon results in complication within the other. The role of the heart needs little comment. It is the pump that sends the blood throughout the body on its mission of food supply and waste collection. The heart may not function normally, there may be changes in the arteries or veins. The kidney may not effectively remove the products intended for urinary excretion. The interrelationship is obvious and complications in any one condition frequently result from association of other factors.

The force with which the heart contracts as it expels blood may be measured. A measurement of blood pressure is a common procedure. With the sphygmomanometer (the blood pressure cuff is an example) it is possible to determine the amount of pressure needed to block the passage of blood through an artery. This systolic pressure represents the tension to which the blood vessels are subjected under the full force of the heartbeat as the heart contracts. As the pressure is released and the blood again flows through, a second pressure level is determined, the diastolic pressure or minimum strain put upon the arteries. This is the decrease in force of pressure as the heart dilates or its period of greatest relaxation. Any abnormality in the heart or in any of the blood carrying vessels will be reflected in these pressure values. While systolic blood pressure varies with age sex gen-

eral health heredity characteristics, time of day, eating habits, climatic conditions state of mind, etc., certain average values can be assumed. Woley's values for systolic pressure are given below

<i>Age</i>	<i>Average Systolic Pressure</i>
15 30	122
31 40	127
41 50	130
51 60	132

The heart itself may suffer functionally or organically, and various parts may be affected the pericardium or outer covering, the myocardium or heart muscles, or the endocardium or membranes lining the heart

In many instances it is desirable to reduce the work of the heart. If the patient is obese, reduction in body weight should receive first consideration in relieving cardiac strain. McLester outlines the disadvantages of obesity as fourfold. First a lack of balance between the body mass and the heart strength, an undesirable condition even when the integrity of the heart is unimpaired. Second, the heart may be the seat of abnormal fat deposits on the surface and between the muscle bundles. This condition naturally decreases muscular efficiency. Third accumulations of fat in the abdomen may limit free movement of the heart. Fourth atherosclerosis which frequently accompanies obesity may involve the coronary artery which supplies the blood to the heart muscles. Obviously a reduction in the weight of the obese person is desirable, especially if he suffers from some form of cardiac impairment.

In the patient with congestive heart failure the elevated basal metabolic rate must be lowered. A reduction of the total caloric intake is frequently the initial therapy. In some instances the Karrell Diet (see Chapter 38) is recommended for the first 24 or 48 hours. The diet may then be modified with the addition of such foods as cereal fruit juices soft cooked eggs toasted white bread puréed vegetables gelatins custard and pudding. Others suggest using approximately a 400 calorie diet initially, and still others recommend an 800 calorie diet. Of course, the vitamin and mineral content of such regimens should merit consideration. Beneficial results have been reported by using a 1,200 calorie diet.

Undernutrition brought about by a subcaloric diet has been thought responsible for such improvement in the patient with congestive heart failure as a drop in both systolic and diastolic blood pressure, a decrease in the size of the heart and an increase in the blood flow. By lessening the burden of the heart its efficiency is improved. McLester and Darby point out that even the cardiac patient who is not obese may benefit from an undernutrition regimen.

The reduction diet should be planned to be entirely adequate to maintain good nutrition while a slow steady weight loss is brought about. Glucose has beneficial effect on the myocardium and a high carbohydrate diet is therefore indicated. Liberal vitamin B<sub>1</sub> is recommended or better the use of the entire complex inasmuch as it has been beneficial in the cardiac changes accompanying pellagra and experimental data indicate the importance of the synergistic (working together) action of the vitamins of the B group. There is also evidence that vitamin C has something to do with myocardial health. Protein must be adequate in order to spare tissue protein. Low serum protein is not uncommon in the latter stages of cardiac dysfunction. Dynamic action is not desired and therefore adequate but not excessive protein is indicated. The diet must be planned to prevent digestive upset and flatulence, therefore readily digested foods are given. Curtailment of fat is advised in the interests of rapid gastric evacuation. Small frequent feedings may be desirable rather than the customary three meal schedule.

It may be necessary to institute measures designed for the prevention or elimination of edema. Wohl indicates that a diet low in sodium and acid ash without the restriction of fluid intake (which was previously prescribed) is effective in treating edema. Foods low in sodium are discussed in the following paragraphs under hypertension.

### Atherosclerosis

The exact cause of atherosclerosis is not known. Heredity and constitutional predisposition would seem to play a part, but, in any event the circulation is impaired. McLester and Darby suggest that it has its inception in childhood and that after adolescence it is present in some degree in almost everyone. Confusion often exists between arteriosclerosis and atherosclerosis. Ar

arteriosclerosis is a pathological condition which is characterized by changes in the blood vessel walls such as excessive growth of connective tissue in the muscular layers or the abnormal deposition of extraneous material within the inner layers of the arterial wall. These changes which are believed not to be a part of the normal aging process result in narrow rigid blood vessels. This condition is often referred to as hardening of the arteries.

Atherosclerosis on the other hand usually refers to that condition in which cholesterol in combination with fatty acids and protein are deposited in the inner layers of the blood vessels. In contrast to arteriosclerosis and atherosclerosis normal aging is characterized by a loss of muscle tone and dilation of the blood vessels.

Recent research has focused attention upon atherosclerosis. Studies have been directed toward gaining an understanding of the primary cause for the depositions described. Atherosclerosis has been produced experimentally in animals notably rabbits and dogs by repeated large doses of cholesterol. However many have indicated that it is treacherous reasoning to extend such findings in experimental herbivorous animals to omnivorous human beings.

Some research indicates that there may be a relationship between hypercholesterolemia and atherosclerosis. As Gofman points out the nutritional problem is to determine what role nutrition plays in the control of serum lipid levels regardless of how the serum lipids are described.

There have been two major approaches recently in the dietary treatment of atherosclerosis. One approach has been directed toward the reduction of the overweight patient who has atherosclerosis. In some cases it was noted that these patients had high levels of serum lipids. Some of these patients benefited from the correction of overweight that is the level of serum lipids was reduced. However in many patients who were overweight with elevated serum lipids the serum lipids were not reduced when the patients lost weight. Many overweight individuals do not have a high level of serum lipids and many normal or underweight individuals are found to have a similar high serum lipid level. Thus while overweight may be considered a contributing factor to elevated serum lipids it cannot be designated as a cause and effect relationship in atherosclerosis.

A second dietary approach in the treatment of atherosclerosis has been the restriction of fats specifically cholesterol. This restriction has been based in part upon the animal experimentation cited in which large dosages of cholesterol have been induced and a condition resembling atherosclerosis has resulted and upon the observation of some patients with elevated serum lipids which are reduced when the intake of fat is lowered. The restriction of fat and dietary cholesterol in atherosclerosis is one of the most controversial areas in diet therapy today. It is recognized that cholesterol is not a dietary essential as it may be synthesized by the body. Cholesterol is a normal constituent of the blood. One of the primary objections to the dietary restriction of cholesterol is that it is found in so many nutritionally valuable foods, eggs, milk, meats. It has been reported that a diet without any fats at all both vegetable and animal will reduce cholesterol in the blood.

TABLE III  
CHOLESTEROL CONTENT OF FOODS\*  
Mg per 100 Gm fresh material

	Mg	%
Bacon	38.78	
Beef	38.78	
Brain	2130	3700
Chicken	59.527	
Kidney	200	3400
Liver	130	3400
Pancreas	3120	
Pork	46.48	
Veal	84	111
Fish	21.95	
Oyster	215	
Salmon roe	1100	
Bacon fat	108	
Butter	185	340
Cod liver oil	400	
Fats—lard, suet	100	350
Milk cow's whole	12	
Milk cow's skim	11	
Cheese	42.88	
Egg whole	240	490
Egg yolk	1180	150

\*Data on cholesterol content of foods lack uniformity. Values here are compiled from data by T. J. Alls and Greene, J. A. M. A. 101, 1841, 1933, and summaries from Cook, Nutrition Abstr. & Rev. 1, 1, 1947. Cholesterol is an animal product. It does not occur in plants or in lipids derived from plants. See also Okey, Ruhl, Cholesterol Content of Foods, J. Am. Dietet. A. 21, 341, 1945, and Mann, George V., Dietary Aspects of Cholesterol Metabolism and Disease, J. Am. Dietet. A. 21, 389, 1949.



Many clinicians believe that there is no conclusive evidence to date that the ingestion of moderate amounts of foods containing fats and cholesterol is significant in relation to the cause of atherosclerosis or to the progress of the condition in the patient. It has been suggested that perhaps this restriction might take the form of the elimination of the foods especially rich in cholesterol (see Table 111) and only mild restriction in the use of the commonly used foods, such as eggs and whole milk. The cholesterol content of many foods is included in Table 111. It has been reported that the average food intake may contain approximately 1600 mg of cholesterol. Many low cholesterol diets may range from 100 to 300 mg.

In summary, there is no general agreement in the dietary treatment of atherosclerosis. This may be due to the fact that the relationship between the food intake and the cholesterol content of the blood has not been established. In addition, the significance of the elevated serum lipids as a primary cause of atherosclerosis is not universally accepted. It has been suggested that the answer may lie in a mechanism which regulates cholesterol metabolism which in atherosclerosis, is disturbed so that abnormal deposits occur. Diets restricted in fat or cholesterol content may or may not be prescribed. The extent to which the cholesterol content of ingested foods is restricted will vary. In many cases the overweight patient is placed on a low calorie diet which is believed beneficial in reducing the level of serum lipids. In other instances restoration to normal weight is advised on the basis of the benefit in all cardiac complications and the relationship to the general health and well being of the individual (see Chapter 22).

### Hypertension

Hypertension is not a disease per se but rather a symptom which may result from many causes. Both the underlying cause and the hypertension require treatment. Ninety per cent of all patients with hypertension belong to a group known medically as essential hypertension. This refers to a condition of chronic hypertension of unknown cause or causes. The causes for hypertension may be organic or functional. By organic is meant a structural change in the heart, blood vessels, kidneys, or other organs—a change which will persist. Functional change may

be due to an emotional upset or a transitory cause of some kind. Infection and obesity are frequent factors.

Hypertension is a condition in which persistent elevation of blood pressure above average occurs. A persistent systolic pressure over 150 is usually regarded as significant. Herit and renal involvement are logical sequences. Diet therapy is intended to relieve the strain on the vessels involved. That mild undernutrition is desirable to attain this end is generally accepted. How this condition should be brought about and how extensive it should be has been a matter of conflicting ideas.

While the basic causes for hypertension are as yet unknown there are many factors which have been described by Wakerlin as contributory. Among these are heredity, the condition seems to appear more frequently in some families than others, aging, the majority of patients are in the 40 to 69 age group, body build, hypertension is found frequently in the short stocky sthenic type rather than in the tall lean asthenic type, mode of living, so called high tension living has been thought by many to predispose hypertension, high protein diets, especially diets containing large amounts of red meats, and high fat diets have been accused as contributing factors to hypertensive conditions. Experimentally there is little evidence that these diets are conducive to high blood pressure, popular opinion to the contrary. Wakerlin also points out that there is increasing evidence that nervous, endocrine and renal factors play roles perhaps of varying importance in different patients in essential hypertension.

There is wide variety in the diets suggested for the patient with essential hypertension. Some suggest a diet as well as a life of which the key word might be identified as moderation. Others find that the so called rice diet of Kempner is beneficial. Still others will restrict the sodium content of the ingested food to a varying degree. In some cases the restriction may be described as mild and in others it may be severe. Again diets that are helpful in reducing hypertension in one patient may not be effective in another. In all cases individual prescription is governed by the condition of the patient.

In the first dietary adjustment mentioned moderate amounts of sodium and water are allowed. The major alteration is in caloric intake—an adjusted level adequate to produce and maintain the desired weight. The diet apart from caloric re-

striction, is the same as that recommended in health but with each item more strictly *held in moderation*. In fact, moderation was the key to treatment. Moderation in eating, drinking, smoking, physical and mental effort, and emotional stress, the mental emotional side perhaps having greater emphasis than the dietary. Certainly, there is no clinical condition in which peace of mind, tolerance, cheerfulness, relaxation, rest, and moderate exercise can play a more important part. The condition of the patient will determine the degree of moderation and whether this type of diet is beneficial.

In the past several years there has been widespread interest in the "rice diet." Kempner introduced the diet in 1940 at the Duke University School of Medicine. In 1944 he published reports which described the results of treatment by means of the rice diet of some 150 patients during the previous four years. Table 112 contains the diet as described by Kempner. Patients have remained on the diet from four days to thirty months. Kempner, in 1944, reported a marked drop of blood pressure reduction in the size of enlarged hearts (to normal size in most cases), reduction of edema, and improvement in electrocardiogram readings. In 1954 ten years after his first published reports, Dr. Kempner has extended his observations to more than 2,000 patients treated with the rice diet. He is convinced that its use is extremely beneficial in the treatment of hypertension. He suggests further that the diet should be instituted when the patient can be under clinical observation.

The diet contains approximately 2,000 calories per day, as 5 gm of fat, 20 gm of protein, and 450 gm of carbohydrate. It contains not more than 0.15 gm of sodium and 0.2 gm of chloride. One of the chief objections to the extended use of the rice diet has been its low protein content. Some experiments have indicated that the patient, while seemingly needing less protein than is normally accepted, does not remain in nitrogen equilibrium. Kempner reported that his patients were in nitrogen equilibrium. It has been suggested that the benefits derived from the rice diet came not from any efficacious effect of rice but probably from the fact that this regimen is essentially severely restricted in sodium.

As one would expect this is a diet of extreme monotony as well as one lacking in palatability. Special care must be used in its

preparation. However, Page and Coreoran pointed out that "when prescribed with authority and enthusiasm, when undertaken in the team spirit of the rice houses (all patients on the rice diet eat together at special dining rooms), and when followed by the faintly masochistic, the rice diet admittedly yields some startling clinical results." As Kempner indicated, the diet is monotonous, it has to be eaten quite a while before its full effect becomes apparent, the patients should be in the hospital until

TABLE 112

## KEMPNER RICE DIET

Pro—20 gm, Fat—5 gm, Cho—450 gm, Cal—2,000, Na—0.15 gm;  
Cl—0.2 gm

**Include each day***Rice*

250-350 gm (dry weight) of rice, white or brown

*Fruits*

*uncooked* any fruit with the exception of avocado pears, dates, and nuts

*cooked* any as above

*canned* any as above—there must be no preservative added (benzoate of soda, sulfur dioxide, no artificial color or flavor, no corn syrup)

*dried* not permitted

*frozen* any as above

*jellies and preserves* these must contain no added pectin and no preservative and therefore homemade jellies and preserves are preferable

*Sugar* may be added as desired, brown or white. Glucose or dextrose may also be used (they are less sweet and better tolerated by some people). Honey is also permitted but not maple sugar.

*Fruit juices* any fresh or cooked fruit juice may be used which contains no preservative, artificial flavor or color. Tomato juice is not permitted. The total fluid intake should consist of fruit juices and the amount is limited to 700 to 1,000 cc a day except where variations are advised by the physician for some special condition. No additional fluids of any kind are permitted and this includes water.

**Food forbidden**

Any foods not listed above

Salt in any form

Fat in any form (this eliminates cream, butter, etc.)

Milk

Nuts, dates, and avocados

Preservative, pectin, artificial coloring, etc.

**Supplementations of vitamins and minerals**

Vitamin A 5,000 I U

Vitamin D 1,000 I U

Thiamine 5 mg

Riboflavin 11 mg

Niacinamide 25 mg

Calcium pantothenate 2 mg

Iron (ferrous sulfate) 0.6 gm

they are "regulated" on the diet and constant checks on their blood and urine chemistry should be made, and the diet becomes worthless if it is modified by so called "small" or "minimal" additions according to the patient's own taste

The rice diet has been modified in various ways. Kempner suggested that after a suitable period small amounts of other foods such as nonleguminous vegetables, an egg and 4 ounces of lean meat could be added each week. King proposed that the restricted diet might be followed for a specific critical period and then modify it with essential nutritional supplements and when necessary return to the original diet for limited periods as a temporary therapeutic expedient.

Another suggested modification\* might be that an egg a week and a nonleguminous vegetable and a cup of tea or coffee be added to the diet. At the end of a month 4 ounces of meat fish or liver is included three times weekly, with two slices of salt free bread. A month later this is increased to a serving of meat daily, a second nonleguminous vegetable, and an egg three times weekly. At the end of this month, if progress has continued to be satisfactory egg and potato are allowed daily.

Opinions as to the general acceptance of the rice diet vary. It is extremely difficult for the patient to follow, yet if he believes that it is imperative to his health, he can adjust to it. It has been successful in that a large number of patients reduced the blood pressure.

Recently the low or restricted sodium diet has been used with increasing frequency. Gratifying results are reported, although opinion differs as to the extent of restriction necessary. Just why reduction should relieve hypertension is not clear. Again strict dietary treatment perhaps is justified in spite of insufficient information as to its specific action.

French physicians Ambard and Beaujard suggested a restriction of sodium chloride in the treatment of hypertension at the turn of the century. Allen and Sherril in 1920 were the first to adopt this treatment in America. It is recognized today that it is the sodium ion which must be restricted rather than sodium chloride (salt). Some students confuse the relationship between sodium and salt. Salt is composed of two elements sodium and

\*New England J Med 79 531 1948

chloride. Each molecule of salt is 40% sodium. We obtain sodium from many other sources besides salt. Baking powder, baking soda, sodium benzoate, some public water, and some foods are high in sodium, to name a few. It has been estimated that the average person consumes from 2 to 5 gm. of sodium daily, which is from 7 to 14 gm. of salt.

The extent to which sodium is restricted in the diet must be determined for each patient. Many clinicians have found that severe restriction is necessary for good results. Grollman indicates that he finds excellent response at times when the restriction is held down to 0.5 gm. (500 mg.) daily. "Moderate restriction of sodium fails to influence the blood pressure." Results vary with the nature of the underlying disorder and the duration of the disease. To his mind, the results of this treatment seem to justify the diet restriction. However, he concedes the dangers of deficiency and suggests close watching of such patients.

The American Heart Association in their pamphlet "*Food for Your Heart*," prepared by the Department of Nutrition, Harvard School of Public Health, has set forth three levels of sodium restriction: mild, moderate, and severe. These levels of restriction are compared with the normal daily consumption in the following table:

	Sodium	Salt	Teaspoons of Salt
Normal consumption	3 to 5 gm.	7 to 14 gm.	1 to 2
1. Mild restriction	1.5 to 3 gm.	3.7 to 7 gm.	$\frac{1}{2}$ to 1
2. Moderate restriction	0.5 to 1.5 gm.	1.0 to 3.7 gm.	$\frac{1}{6}$ to $\frac{1}{2}$
3. Severe restriction	Less than 0.5 gm.	Less than 1 gm.	Less than $\frac{1}{6}$

By following the mild restriction of sodium in Table 113, a 50% cut in sodium consumption may be effected; by moderate restriction, a 75% or more may be eliminated; and in severe restriction, as described in Table 113, 90% or more sodium may be cut from that found in the normal diet. Unless weight loss is desired, the calories do not necessarily have to be low. The diets in Table 113 may easily be reduced in calories. There may be many foods in these diets which may be undesirable for other reasons. For example, some patients may not be able to tolerate certain gas-forming vegetables, so some of the vegetables allowed on the low sodium diets would be eliminated.

So far as possible, the low sodium diets should be modified from the family menu. Salt can be added by the other members of the family at the table or, after the dieter's portion has been served, the remaining food can be seasoned. Occasionally, of course the individual on a low sodium diet will have to have foods different from the other family members. However, the diet need not be a "special" one.

*Milk* is quite high in sodium (50 mg per 100 cc), and, for that reason, it is limited to 1 pint on the mild and moderately restricted diets. It must be omitted on the diets severely restricted in sodium. However, if this is done, the diet will be low in calcium and possibly other important nutrients. Low sodium milks are available in powdered form. To many patients they are expensive and unpalatable. Irwin and Schuck report that they found the greatest acceptability when the dialyzed milk (low sodium) was used in the form of milk soups. Cheese also contains large amounts of sodium, especially cheese containing whey. Sodium, being water soluble, is found mostly in the whey fraction. Cottage cheese may be made salt free if it is placed in a plastic bag and then thoroughly washed by running cold water for at least one hour. In many communities low sodium cottage cheese is available in the markets.

*Fruits* may be used in any form in the low sodium diet. However, care must be taken that jams or jellies do not contain sodium benzoate. Many dried fruits are processed with sodium acid sulfite prior to drying.

*Vegetables* are usually allowed in the fresh and frozen state. Sodium chloride is used in the flotation process in sorting green peas and Lima beans from hardened peas and heavy extraneous matter and sodium chloride is also used as a blanching agent in freezing foods. If there is no information on the label indicating that sodium has been used in commercial processes, it is advisable to check with the manufacturer before using products which might contain undetected sodium. Most commercially canned vegetables and vegetable juices have added salt. However, vegetables canned without salt are available.

*Fresh meat, fish, and poultry* have a fairly high content of sodium and, therefore, the amounts of these foods are limited. These foods are included in the diet for the necessary nutrients.

they provide namely, protein the B complex and iron even though they may supply sodium as well. Most canned meats fish and poultry are salted however increasing amounts of these foods are canned without salt.

Unsalted or 'sweet' butter is available to most individuals. As a change both vegetable oils and lard contain negligible amounts of sodium and may be used as fat as well as butter.

Salt has been added to many of the ready to eat cereals. Some however are free of sodium. Among those that may be used on the low sodium diet are puffed wheat shredded wheat macaroni spaghetti puffed rice and regular oatmeal Cream of Wheat and Farina. The label may or may not tell if sodium has been used in processing but commercial concerns are willing to provide such information upon request.

Apart from foods there are many other sources of sodium. One of the chief might be *drinking water*. The sodium content of the drinking water of many major cities in the United States can be found in Table 124B in the Appendix. Usually the local water department or the state department of health has this information. Other sources of sodium might be water softeners tooth pastes mouthwashes and many medications such as cathartics and headache remedies.

Sodium is used in many forms in *preparing or preserving foods*. One of the most common is baking powder or baking soda. Commercial breads contain sodium as well as cakes and cookies. Recently low sodium bread has become widely available and to facilitate home baking if the calorie allowance and the diet permit low sodium baking powder may be purchased. Prepared biscuit bread panicle and waffle mixes all contain salt.

If one were to calculate from Table 124 the sodium content of foods it may be seen that salt free bread and butter are musts when sodium restriction is at a low level.

Many *herbs* and *seasonings* do not contain sodium and may be used freely to improve the palatability of the diet. Among those which are acceptable are allspice bay leaves celery, cinnamon, curry powder, garlic, marjoram, nutmeg, paprika, parsley, pepper (black, white and red), sage, thyme and vinegar. Vanilla and almond extracts are allowed flavorings and other seasonings are dry mustard, saccharine and fresh onion flavoring.



In many cases a salt substitute is allowed. Some contain sodium and others contain minerals which would not be advisable to all patients. The physician prescribes which substitute, if any he recommends for the patient.

The Newton Health Department of Newton, Massachusetts, has developed and published a booklet, *Planning Low Sodium Meals*, which is designed for the patient and physician. It contains several diets of varying degrees of sodium restriction, developed as an exchange method similar to that of the diabetic exchange described in Chapter 30. It contains clear, descriptive information about the diets, the content of foods, and has many suggestions about the preparation of foods that are low in sodium. Illustrations clarify what is meant by designated portions of food.

Obviously, the severely restricted sodium diet should be adequate in all respects except sodium. As soon as possible, the intake should be gradually increased. Symptoms of nutritional deficiency as well as dehydration should be watched for.

To summarize the diet in hypertension may be one of choice. The plan may be moderation in diet and activity, the rice diet may be preferred or sodium restriction can be practiced. Under nutrition or a reduction in weight may be the sole dietary treatment or it may be prescribed in combination with a restriction of sodium. The future and additional controlled studies will give the answer to the most effective dietary management of hypertension.

For the convenience of those engaged in the difficult task of planning low sodium diets, the figures on sodium values of food (Table 124) prepared by Mead Johnson and Company can be found in the Appendix.

### Other Circulatory Disorders

In coronary occlusion the primary concern is complete rest for the patient for the first 24 to 48 hours. Little nourishment is given, although some institute the Karrell diet at this time (see Chapter 38). McLester and Darby suggest that the total fluid intake should be limited to 1 000 to 1 500 c.c., but that there is no fixed rule. Water and fruit juice may be offered during the acute stage, as well as milk.

TABLE 113

## ILLUSTRATIVE DIETS—THREE LEVELS OF SODIUM RESTRICTION\*

	MILD RESTRICTION 153 GM SODIUM 110—85, FAT—170, CHO—260 (CALORIES—2550)	Moderate RESTRICTION 6515 GM SODIUM 110—80, FAT—125, CHO—260 (CALORIES—2485)	SEVERE RESTRICTION 62 GM (200 MG) SODIUM FRO—70, FAT—80, CHO—210 CALORIES—2000
Milk	1 pint	1 pint	1 pint (low sodium)
Meat	5 or 6 oz	5 oz	3 or 4 oz
Egg	1 or another or meat	1 or another or meat	1 or another or meat
Vegetables	3 or 4 servings	3 or 4 servings	4 or 5 servings†
Bread or alternate	7 servings	7 servings (low sodium)	8 servings (low sodium)
Fat	12 servings (4 Tbsp)	12 servings (unsalted)	10 servings (unsalted)
Cream	1 oz (2 Tsp)	1 oz	-----
Jam, jam	9 tsp	9 tsp	6 tsp
Dessert‡	1 serving	1 serving	(Made from foods from this list)
Fruit	3 or 4 servings	3 or 4 servings	4 or 5 servings§
Unsalted nuts	-----	-----	1½ cup
Don't Use	Salt at the table Salt preserved foods, such as ham, bacon, dried beef, salted fish, olives, bologna or sausage, anchovies, sauerkraut, bouillon cubes, meat extracts Highly salted foods, such as salted nuts, potato chips, crackers Relishes, such as ketchup, pickles, prepared mustard, Worcestershire or meat sauces, celery salt, garlic salt Cheese (unless specially prepared without salt) Peanut butter (unless specially prepared without salt)	All foods omitted in mild restriction Salt in any kind of cooking Canned vegetables, meat, fish or soups (unless prepared without salt) Frozen peas, Lima beans, or frozen fish fillets Fruits preserved with benzoate of soda Shellfish, except oysters Salted fats, such as butter, margarine, and bacon fat Ordinary bread Anything cooked with soda, baking powder, prepared flour mixes, or prepared flours	All foods omitted in mild and moderate restriction Beets, carrots, celery, cooked greens of any kind Instant tea in instant coffee (some are processed without sodium), Postum, cocoa Milk (except dialyzed or low sodium) Dutch process cocoa Malted milk or Ovaltine

\*Adapted from *Food for Your Heart* American Heart Association

†Puddings made from low sodium milk part of milk allowance Jam, jelly, honey

‡Only these vegetables permitted asparagus avocado beans (green snap), Brussels sprouts cabbage corn cucumbers eggplant leaf lettuce mushrooms okra onions parsnips peas (fresh) peppers (green) potato (sweet or white) pumpkin radishes squash (acorn Hubbard summer) tomatoes turnips (yellow) almonds beans (navy fresh Lima soy)

§Only one serving daily of cantaloupe fruit cocktail kumquats pears (canned) plums (canned)

As the patient progresses, the diet is usually slowly increased. It may be both a low calorie diet and a soft diet which is low in sodium. Diets varying from 400 to 1,200 calories have been suggested at different stages in the patient's illness. Under nutrition, with its goal as a decreased basal metabolism and loss of body weight, is the basic principle in the dietary management of coronary occlusion. The specific calorie prescription, the extent of sodium restriction, and the rate of increase cannot be generalized but must be determined for each patient.

The patient with *angina pectoris* requires simple, easily digested foods which will place the smallest burden upon the digestive system. Small meals with in between feedings are frequently suggested. If the patient is overweight, it is usually recommended that he reduce. In most cases the calorie intake is restricted. Meat and coffee are allowed in moderation.

A word about the relationship of nutrition to rheumatic fever. There have been several surveys in the past twenty years which have sought to determine the nutritional status of children with this condition. Considerable evidence has been obtained that nutrition is an important factor in the genesis of the rheumatic state, however, a single nutrient has not been isolated as being a sole deficiency, as the diets are usually inadequate in a number of nutrients. Chief among them are protein, vitamins A and D, calcium, phosphorus, and iron. Deficiency in vitamin C has also been reported. Rheumatic fever itself is of doubtful origin though it is believed to be precipitated by an upper respiratory infection due to a group A hemolytic streptococci. It is thought by many investigators that a host factor which is closely linked with nutrition either directly or through its effect on the state of immunity may explain why some children develop rheumatic fever and others do not. Further studies may establish how the nutritional status of children, among other environmental factors as well, is responsible for the development of rheumatic fever. Of further importance is the nutritional care of the child in the active and inactive stage of the disease. (See discussion of fevers Chapter 29.)

### Review Questions

1. In what respects are the kidneys and the circulatory system interdependent?

- 2 At what point is systolic pressure of the heart considered abnormal or hypertensive?
- 3 What factors must be considered in planning dietary adjustment for a person with heart disease?
- 4 What are the principles of dietary treatment in the patient with congestive heart failure?
- 5 What is the difference between arteriosclerosis and atherosclerosis? Normal aging?
- 6 What are the various dietary adjustments recommended in atherosclerosis?
- 7 What are the principles underlying each one?
- 8 What are some of the contributory factors in hypertension?
- 9 What are the various dietary adjustments suggested for the patient with hypertension?
- 10 What are some of the principal objections to the "rice diet"?
- 11 To what extent may the diet be restricted in sodium?
- 12 How may the diet be adjusted for the patient with angina pectoris? Coronary occlusion?

### Suggested Projects

- 1 Calculate the cholesterol content of your own menus. Which foods do you particularly enjoy that are rich in cholesterol? Can you easily substitute other foods for them?
- 2 Plan a week's menu for the Kempner Rice Diet, including as wide a variety as possible in ways of serving foods.
- 3 Calculate the nutritive value of one of the days included in Project 2. Which nutrients are below the Recommended Daily Allowances (without supplementation)?
- 4 Plan a diet that is severely restricted in sodium (Table 113) for a 45 year old man. Which difficulties did you encounter in fulfilling your prescription? Are you able to meet his nutritive requirements?
- 5 Plan several days' menus that are low in sodium and that use a variety of herbs and spices as seasonings. If possible, try some new combinations in your home to ascertain their acceptability.
- 6 Examine your own menus for foods high in sodium. Which foods would you have to omit from your diet if your intake were restricted in sodium?
- 7 Plan a restricted sodium diet for yourself. Follow this diet for a week. What problems did you encounter in adhering to this regimen? Did you become accustomed to the foods? Did you try any salt substitutes? Were they acceptable?

## CHAPTER 40

### THE ANEMIAS

Chief among the anemias are the deficiency anemias and pernicious anemia. The former are due to a lack of iron or hemoglobin producing foods. The latter is associated with the inability of the body to produce mature red blood cells. There are also other groups of anemias. The deficiency anemias are treated by a proper diet and iron therapy. In some conditions folic acid is helpful. Vitamin B<sub>12</sub> is dramatically effective in pernicious anemia. A high protein diet is usually indicated and frequently liver extracts are administered.

The term anemia (*a*—without + *emia*—blood) denotes a diminution of the normal number or volume of red blood corpuscles or in the amount of hemoglobin in a unit of circulating blood. The result of either condition is a lowering in the capacity of the blood to combine with and transport oxygen to the tissues. The number of red blood cells or corpuscles (RBC) and the amount of hemoglobin (Hb) vary in normal persons with age, sex, geographic location and degree of activity and hydration of the individual. However, certain approximate normal values may be assumed. Five million red blood cells per cubic millimeter of blood may be considered average for men, for women the number is somewhat less. The cells occupy 45% of the total volume of blood in any individual, the remainder, or 55%, is plasma. Hemoglobin is present in the amount of 14.5 gm per 100 cc of blood or 14.5% of the total volume (see Chapter 9, Blood). Blood makes up *approximately* 7% of the body's weight, but it contains 70% of the body's iron. Alteration in these values and consequent lowering in the oxygen supplied to the tissues produce symptoms such as headache, faintness, weakness, abnormal fatigue, increased sensitiveness to cold, irritability, and lack of power of concentration. In severe anemia these are intensified and gastrointestinal upsets, difficulty in breathing, heart murmurs etc., may be added to the symptomatology. Certain symptoms are characteristic of a type of anemia and so are helpful as differentials.

In order to build red blood cells, normal in kind and number, the bone marrow must have available protein, iron, vitamins B and C, and the thyroid hormone. Further, once the cell is formed, it requires the stimulus of a substance produced in the stomach wall ("a specific erythrocyte maturing substance") if it is to mature and leave the bone marrow. Under normal conditions bone marrow produces 1,000,000,000,000 red blood cells a day. In health, an equilibrium is maintained between blood formation and blood destruction, and if this is disturbed, anemia results. The span of life of each red blood cell is probably from 60 to 90 days. Eventually it is broken up and "scrapped for junk" after the iron is salvaged for re-use. The rest of the hemoglobin molecule is converted into bile pigment, and after playing its part here, it leaves the body by way of the feces to which it imparts the characteristic color.

Anemias are described as hyperchromic or hypochromic, depending upon the color index or upon the amount of hemoglobin present. As is evident from the terms, hyper indicates that more than the average amount of hemoglobin is present, and hypo that the hemoglobin is below average. The descriptive adjectives microcytic, normocytic, and macrocytic may be used, in addition to indicate the size of the cells—less than average, average, or greater than average in size.

Primary and secondary are terms formerly used in describing anemias, *primary* indicating failure of the bone marrow to produce normal red blood cells, and *secondary* indicating an anemia as the result of factors other than cell production, such as blood loss, food deficiency, pregnancy, etc. This grouping is, however, being replaced by more detailed descriptions.

Classification of the anemias is difficult because of the many complications and causes. Several classifications have been suggested. A simple one follows:

**Deficiency anemias.** Under this heading may be grouped the deficiencies due to lack of iron or hemoglobin-producing foods. Infants fed too long upon a milk diet frequently develop anemia due to the low iron content of milk. In pregnancy, if intake of food is below utilization, or in any condition where the loss of red blood cells exceeds production by the bone marrow, as in hemorrhage, anemia results. McLester and Darby suggest that

an iron deficiency anemia which occurs in adults should be considered evidence of current or past blood loss

Chlorosis, a disability occurring in young women, was encountered in years past, but today it is rarely described, probably because of better nutrition and diet, and the modern tendency to classify this condition simply as hypochromic anemia due to deficiency. The anemia occurred usually at puberty, the period of rapid growth, or during the establishment of menstruation when the demand for iron is relatively great.

*Treatment* of iron deficiency anemia rests on two basic principles: (1) the correction of the inciting cause, if diagnosed and (2) the administration of iron, usually in the form of ferrous sulfate. The excellent response to iron therapy in the hypochromic anemias suggests that the beneficial change in condition is due "to relief of a deficiency and not to a stimulation of unspecific nature since administration of iron to a normal individual or to one suffering from pernicious anemia, does not increase blood production."

Iron therapy is usually continued for 2 or 3 months at least. Folic acid, a member of the B complex (see Chapter 12), seems to be effective in anemia of pregnancy as well as in megaloblastic (giant corpuscles) anemia of infancy.

In this group of deficiency anemias also belongs the anemia characteristic of scurvy, brought about by lack of vitamin C, the anemia found in pellagra and beriberi, caused by deficiency of the specific B vitamins (nicotinic acid and  $B_1$ ), and the anemia which results from hemorrhage following a vitamin K deficiency with its subsequent prolonged clotting time.

An anemia caused by lack of ability to absorb food normally, occurring in certain gastrointestinal disorders, also belongs to this group.

Inadequacy of protein of high biological value and thyroid deficiency are other causes of anemia. In fact, *anemia is often but one symptom of defective nutrition*.

This second group of deficiency anemias is the result of inadequacy of or an abnormal utilization of food. They may be treated primarily by proper dietary practice. An entirely adequate diet, supplemented by the factor whose lack was responsible for the development of the anemia, is the treatment of choice in these

conditions. The dietary history and the associated symptoms of the anemia usually reveal the underlying cause of the disease and indicate what factor or food constituent must be employed to rectify the condition and make the diet entirely adequate in all essentials for red blood cell construction.

Certain foods notably liver promote blood regeneration out of proportion to their protein vitamin and mineral content. The liver cell so intimately concerned with pigment metabolism apparently is the storehouse of the pigment complexes which are the parent substances of hemoglobin. Considering liver as 100 per cent effective in the production of hemoglobin Whipple and his co workers arrive at the values given in Table 114.

TABLE 114

---

Liver	100%
Chicken liver	90%
Gizzard kidney	80%
Apricots peaches	50%
Prunes raisins apples	35%
Lean meat	3%
Sweet peas and lima beans	20%
Green leafy vegetables	15%
Eggs	1%
American cheese	10%
Butter	1%
Milk cream	1%

---

Summarizing it can be seen that liver kidney and gizzard are the most potent sources of hematopoietic substance. They have the greatest stimulating effect on cell production. The group next highest includes apricots peaches apples and prunes. Following these are the muscle meats and then a relatively inert group including the leafy vegetables dairy products and cereal grains.

Iron or iron and copper medication may or may not be indicated in conjunction with the dietary change and its use is debated. It is however of value in addition to high dietary intake of iron in many cases.

**Pernicious anemia** or Addison's anemia (not to be confused with Addison's disease) is also a deficiency anemia since it is due to an inability of the body to produce the factor which has stimulating effect on the maturation of the red blood corpuscles known variously as the hematopoietic liver principle the erythroblastic liver principle and the antipernicious anemia principle or



factor. The substance is apparently liberated in the gastrointestinal tract by interaction between some constituent of the gastric juice (called by Castle the *intrinsic factor*), and a water soluble dietary constituent known as the *extrinsic factor* which is found in many foods. The iron supply is adequate but, lacking the intrinsic stomach factor, the individual is unable to manufacture his own liver fraction. This intrinsic factor, when present, is stored in the liver, from whence it is released to stimulate the bone marrow to produce normal erythrocytes, and to release them to the circulating blood.

In pernicious anemia achlorhydria (low gastric hydrochloric acid), gastrointestinal symptoms such as sore mouth, "beefy" tongue, loss of appetite, diarrhea or constipation, and abdominal pain occur.

Today, on the basis of recent research, it is believed that pernicious anemia patients lack the intrinsic factor and therefore fail to absorb vitamin B<sub>12</sub> effectively. It is generally agreed that there is little understanding of the mechanism of action of the intrinsic factor beyond its ability to increase the absorption of vitamin B<sub>12</sub>. Usually, small amounts of the vitamin are effective in the treatment of pernicious anemia. Folic acid therapy is not helpful in this condition.

Before the discovery of vitamin B<sub>12</sub> and its role in the treatment of pernicious anemia, "heroic" amounts of liver were served daily to the patient. Liver was prepared in many ways such as homogenized in the form of a "liver cocktail," as a pâté and used as a sandwich filling, and as the meat course for both dinner and supper. Today, we recognize that the beneficial effect of these high liver diets lies in the fact that they contained large amounts of vitamin B<sub>12</sub>. Liver is still an excellent food for the diet of patients with pernicious anemia, however, a diet rich in protein, vitamins, and minerals is usually prescribed.

In some cases liver extract is administered to the patient in pernicious anemia.

A second group of anemias results from interference with blood regeneration of such nature that red blood cell elaboration (hematopoiesis) cannot take place.

There may be physical injury to the blood forming organs by prolonged radiation x-ray, radium and accidental absorption of radioactive material (in industry).

Mechanical interference with blood forming organs due to obliteration of potentially active bone marrow (despite the maximum productivity of the remainder) results in an inadequate number of red blood cells. Carcinoma, acute and chronic leucemias, miliary tuberculosis or Hodgkin's disease, and occasionally tumors in the bones and osteosclerosis (pathological bone marrow change) may be the causative agent.

There are also idiopathic disturbances of the blood forming organs 'for which there is no immediate explanation'—aplastic anemia (where cells are not formed in the bone marrow), the megalocytic anemia of liver disorders, especially of cirrhosis, the so-called splenic anemia and certain congenital erythroblastic anemias (anemia of the premature infant or the type variously called Mediterranean or Cooley's anemia, which was described first by von Jaksch and is occasionally called by his name).

Finally, there are anemias caused by actual disintegration of the blood by the action of infective organisms, intestinal worms, cancer, extensive burns or hemolytic poisons. In these, dietary adjustment other than directed toward improvement of general health is ineffective.

### Review Questions

1. What does the term anemia denote?
2. What is the average number of red blood cells per cubic millimeter of blood in healthy men?
3. What amount of hemoglobin in 100 cc. of blood is considered normal?
4. Where are red blood cells formed?
5. What nutrients are essential to the formation of red blood cells, normal in kind and number?
6. What is necessary for their maturation?
7. What is meant by deficiency anemias?
8. What are the dietary indications in deficiency anemias?
9. What foods have been found especially valuable in blood regeneration?
10. In what respect does pernicious anemia differ from other deficiency anemias?
11. What are the fundamentals of treatment in pernicious anemia?
12. In addition to the above, what are some other believed causes of anemia?

## CHAPTER 41

### FOOD ALLERGY

One of the greatest challenges in dietotherapy is the diagnosis and treatment of food allergy. Modified diets are used extensively. "Elimination" diets, "allergy free" diets, and "provocative" diets are often part of diagnostic methods in allergy. Care must be taken to provide nutritionally adequate meals throughout these periods of extreme restriction. Once the offending food has been determined, ingenious means are frequently necessary to provide a wholesome and varied diet.

There is nothing new about allergy except the name itself, which indicates altered reactions or abnormal response. Certain individuals, for some unknown reason, are hypersensitive to certain substances. Such people break out in a rash, develop hives, sneeze, suffer from asthmatic attacks, severe headaches, ringing and pressure in the ears, or are afflicted with flatulence, cramps, nausea, diarrhea, or vomiting. Why? Scientists wish they knew. Apparently abnormal cell reaction of some kind is the cause. If the irritable cells are in the nose, sneezing develops, if in the throat, coughing results, if in the stomach nausea, cramps, and even vomiting, may follow, and if in the lungs wheezing or asthma occurs.

While any one of the symptoms may result from contact with the offending substance, there is a tendency for certain substances to cause reactions in somewhat localized areas, for instance, asthma or respiratory tract irritation usually results from the pollens, dust, feathers, or from the dairy products. Wheat and other cereals are frequently the causative agent for migraine (a specific type of headache). Milk, eggs, cereals, and pork should be suspected first in skin rash. Strawberries, tomatoes, chocolate and fish are the most frequent cause of hives. Food allergies must not be confused with food poisoning (see Chapter 17), vitamin deficiencies (Chapters 11 and 12), or with dermatological conditions.

Rinkle and his associates in an extensive monologue devoted to food allergy, have defined food allergy as "a term used in refer

ence to those foods for which it is possible to demonstrate a cause and effect relationship between the ingestion of a specific food and the production or accentuation of allergic symptoms. This relationship must not only exhibit specificity but it must be demonstrable repeatedly and upon every occasion when the tests are performed correctly.



Fig. 70 Infantile eczema in a child sensitive to milk and eggs. (From Sutton and Sutton: *An Introduction to Dermatology*. The W. B. Saunders Co.)

Unfortunately allergy has been exploited to such an extent that it has become in many instances a fad resulting in dietary maladjustment. There are undoubtedly many unrecognized food sensitivities existing that cause preventable ill health. When the sensitivity is real it is of great importance that dietary adjustment be made but it is of equal importance that the diet be so planned that deficiencies do not result. Careful substitution is necessary and padding with commercial products may be im-

perative Diets for allergic conditions should always be supervised by someone trained to recognize nutritional needs, who understands biological relationships of foods, and who can ferret out minor causative factors that may be obscure to the casual observer. In allergy the fault lies in the body cells, not in the food. The offending material may be one or more of a vast number

TABLE 115  
FOODS FREQUENTLY CAUSING ALLERGIC SYMPTOMS  
ARRANGED IN ORDER OF FREQUENCY

FOOD	FREQUENCY	FOOD	FREQUENCY
Wheat	61	Grapefruit	3
Chocolate	44	Pineapple	3
Egg	35	Ginger	3
Milk	26	Lettuce	3
Beans	21	Mint	3
Peas	18	Oats	3
Potato	17	Lamb	3
Tomato	16	Spices	3
Corn	16	Cinnamon	3
Beef	15	Carrot	3
Onion	15	Strawberry	2
Pork	13	Sweet potato	2
Fish	13	Cucumber	2
Nuts	10	Cherry	2
Cantaloupe	9	Cheese	2
Peanut	8	Cauliflower	2
Black pepper	8	Cocoonut	2
Chicken	6	Green pepper	2
Asparagus	6	Tea	1
Orange	5	Raspberry	1
Apple	4	Blackberry	1
Grape	4	Gloves	1
Cabbage	4	Garlic	1
Rice	4	Rye	1
Liquor	4	Veal	1
Peach	3	Mustard	1
Spinach	3	Celery	1
Almonds	3	Plum	1
Watermelon	3	Lemon	1

From Eyermann Food Allergy as a Cause of Vasomotor Rhinitis South  
M J 81 210 1938 Reproduced from Hawley Maurer Mast The Fundamentals  
of Nutrition Charles C Thomas

Eyermann has listed, in Table 115, the frequency with which foodstuffs induced symptoms of nasal allergy in his series of 181 cases.

Although an allergic attack may be caused by food, house dust feather pillows, the horse, dog, or cat, some garden plants and

weeds a brand of face powder, and other things only food allergy will be discussed here

Treatment in all types of allergy is essentially the same namely desensitization or the avoidance of the offending substances. There is no real difference between the various types of allergic reactions. Fundamentally they are all manifestations of the same abnormal condition of hypersensitivity. Symptoms may be mild or severe they may occur almost at once or they may be delayed from half an hour to several days. The longer time complicates the picture and obscures the cause.

While food allergy generally results from the ingestion of the food the mere handling of it may precipitate an attack and unbelievably minute traces may cause an attack in a highly sensitive person. The meat of the hen has been reported as bringing on an allergic attack in a person sensitive to egg whereas the same individual could eat rooster meat with impunity. Or an attack may result only when large amounts of an offending material are ingested. The strange forms in which the sensitivity manifests itself may at times be very misleading. All these factors tend to make allergy a fascinating study but one requiring ingenuity and intelligent cooperation from the patient.

Allergy frequently occurs in more than one member of a family or in succeeding generations. The tendency to be sensitive is not always transmitted with the symptoms in the same form nor does the same form always exist in the same person throughout life. A child may exhibit eczema in infancy and apparently outgrow it and suffer later from asthma for some years only to have this yield to gastrointestinal symptoms.

Diagnosis is difficult. Several methods in addition to careful history are suggested. Food extracts are injected into the superficial layers of the skin in the skin test. In the scratch test a drop of the food extract is placed on a scratch made on either the arm or the back. A positive reaction following the contact between body cells and the prepared allergens (the extracts of suspected substances) may help to implicate an offending substance. These tests are not infallible but may be indicative. The positive test consists in the development of an urticarial wheal or raised area surrounded by an erythematous or reddened zone. The "leucopenic index" is also sometimes used. This is based on the assumption that following digestion of a food to which

the patient is sensitive, the total leucocyte count in the blood usually falls. It is probable that the only reliable method for detecting the causative agent is through a carefully kept diary of the food eaten, activities, and environment. This, if sufficiently complete with comments on personal physical reactions to give a fair history of the patient, and used with elimination diets, may enable the doctor to discover the cause of the reaction. It may be a combination of circumstances or foods or an additive effect of several factors, each causing reactions too mild to arouse suspicion. A history of previous health and family ailments may furnish the clue. The history outline suggested by Tuft in his *Clinical Allergy* is well worth reading.

Treatment of allergy is aimed toward the removal of the causative agent. Diets designed to eliminate specific foods are known as elimination diets. They consist of carefully worked out food combinations based on the premise that if an individual is sensitive to a given food, he will undoubtedly react similarly to other foods belonging to the same biological family. Rowe, the pioneer in this method of treatment, has worked out four diets which bear his name and are known as Nos 1, 2, 3, 4. Each diet eliminates certain foods or food groups and emphasizes others.

By following a diet for a period of days it is possible to ascertain whether the foods contained in the diet, or eliminated from the diet, are responsible for the attacks. Unfortunately, milk, eggs, wheat, and potatoes, especially the first three, are the chief offenders. A milkless wheatless, eggless diet will alleviate the symptoms if one of these foods is the offender. After a few symptomless days, the cautious addition of first one and then another of these foods will indicate, perhaps, that only one is the offender. If so that food must be eliminated from the diet in every form. If eggs, not only eggs as such, but cakes, pies, puddings made with eggs. Noodles and baking powder, if made with eggs, must be avoided. *One must know the ingredients used in prepared foods.* (See Appendix Table 127 for list of foods and possible allergens they contain.)

Alvarez begins even more cautiously in his treatment. The first diet consists only of lamb, rice, butter, sugar, canned pears, or gelatin. These, experience has taught him, are less liable to cause reactions than other foods. No pepper, sauces, cream, or drink of any kind except water, is allowed. If no reaction re

TABLE 116  
ELIMINATION DIETS

DIET 1	DIET 2	DIET 3	DIET 4
Rice Tapioca	Corn Rye	Tapioca White and sweet potato	Milk*
Rice biscuit Rice bread	Corn pone Corn rye muffin Rye bread Rye crisp	Lima bean potato bread Soya bean lima bean bread	
Lettuce Spinach Carrot Beet Artichoke	Tomato Squash Asparagus Pear String beans	Beets Carrots Lima beans String beans Tomato	
Lamb	Chicken Beef	Beef Bacon	
Lemon Grapefruit leaves	Pineapple Peaches Apricot Prunes	Lemon Grapefruit Peaches Apricot	
Cane sugar Wesson oil Olive oil Salt Gelatin Syrup made of maple sugar or cane sugar flavored with wa- pleins or maple sugar Olives Pear butter	Cane sugar Mazola oil Wesson oil Salt Karo corn syrup Gelatin	Cane sugar Olive oil Wesson oil Gelatin Salt Olives Maple syrup or syrup made with cane sugar flavored with maple	

\*Milk should be taken up to two or three quarts a day. Tapioca cooked with milk and milk sugar also may be taken.

Note—Wesson (cottonseed) oil is included in all diets. With allergy to cottonseed as shown by skin test or history this must be excluded and a cotton seed oil shortening such as Crisco must not be used. If allergy to cane sugar is suspected beet sugar or corn glucose may be used. (Copied from Vaughan, The Practice of Allergy, The C. V. Mosby Co. See Appendix for additional suggestions.)

sults during the ingestion of this diet (a food diary is kept) other foods are slowly added: potato cream, asparagus, carrots, string beans, oatmeal and dextrinized bread over a period of two weeks. With sufficient time interval between additions, it is possible to determine tolerance for each food. Milk, eggs, plum bread and other foods then may be added in turn. See Table 117 for botanical grouping of foods.



TABLE 117

The following edible foods are arranged in accordance with their botanical classification, in such a way that one may readily recognize those which are botanically related and which might cross react \*

(1) <i>Seaweeds</i>	(2) <i>Fungi</i>	(3) <i>Gymnosperms</i>
Agar agar	Mushrooms	Pine nut
Irish moss	Truffle	
	Puff balls	
	Molds	
	Yeast	
(4) <i>Cereal Grains</i>		
Wheat	Barley	Oat
Rye	Malt	Rice
		Wild rice
		Corn

The cereal grains and potato provide the chief source of starchy food. Occasionally nearly all of the cereal grains must be avoided. In this case the following sources of starchy foods, not closely related to other foods may be drawn upon:

Arrowroot	Cassava	Tapioca
Sago (Florida Arrowroot or Indian Bread Root)		
(5) <i>The Palm Family</i>	Date	Jujube
Cocoanut		
(6) <i>Pineapple</i>	This fruit is not closely related to any other food	
(7) <i>Banana</i>	This also has no closely related food	
(8) <i>The Lily Family</i>	(9) <i>The Mulberry Family</i>	
Onion	Mulberry	
Garlic	Hop	
Chive	Fig	
Leek	Breadfruit	
Shallot	(10) <i>The Buckwheat Family</i>	
Asparagus	Rhubarb	
	Buckwheat	
(11) <i>The Walnut Family</i>	(12) <i>The Beech Family</i>	
Walnut	Chestnut	
Pecan	Filbert	
Hickory	Beechnut	
(13) <i>The Beet Family</i>	(14) <i>The Gooseberry Family</i>	
Swiss Chard	Currant	
Beet	Gooseberry	
Spinach	(16) <i>The Rose Family</i>	
(15) <i>The Cabbage or Mustard Family</i>	Strawberry	
Turnip	Raspberry	
Rutabaga	Blackberry	
Cabbage	Dewberry	
Kale	Loganberry	
Collard	(17) <i>The Apple Family</i>	
Cauliflower	Apple	
Broccoli	Apple Butter	
Brussels Sprouts	Crab Apple	
Kohlrabi	Quince	
Mustard	Pear	
Radish	Apple pectin is widely used in commercial jellies such as mint jelly and in some candy such as Turkish paste and gum drops	
Horseradish		
Water cress		

TABLE 117—CONT'D

- |                                      |                               |
|--------------------------------------|-------------------------------|
| (18) <i>The Plum Family</i>          | (19) <i>The Legumes</i>       |
| Peach                                | Lentil                        |
| Nectarine                            | Kidney bean                   |
| Apricot                              | Lima bean                     |
| Almond                               | String bean                   |
| Plum                                 | Blackeye pea                  |
| Prune                                | Soybean                       |
| Cherry                               | Pea                           |
|                                      | Peanut                        |
| (20) <i>The Flax Family</i>          | Peanut butter                 |
| Flaxseed                             | (21) <i>The Citrus Family</i> |
| (Unseed)                             | Citron                        |
| (22) <i>The Pistachio Family</i>     | Orange                        |
| Pistachio nut                        | Tangerine                     |
| (23) <i>The Grape Family</i>         | Bergamot                      |
| Grape                                | Lemon                         |
| Raisin                               | Grapefruit                    |
| Current (dried)                      | Lime                          |
| Wine                                 | Limequat                      |
| Brandy                               | Kumquat                       |
| Grape vinegar                        | (24) <i>The Mallow Family</i> |
| Grapejuice                           | Cottonseed                    |
| (25) <i>The Chocolate Family</i>     | Okra (gumbo)                  |
| Chocolate                            | (26) <i>The Tea Family</i>    |
| Cocoa                                | Tea                           |
| Cocoa butter                         | (27) <i>The Carrot Family</i> |
| (28) <i>The Laurel Family</i>        | Carrot                        |
| Cinnamon                             | Parsnip                       |
| Avocado or alligator pear            | Parsley                       |
| Bay leaves                           | Celery                        |
| (29) <i>The Huckleberry Family</i>   | Celeriac                      |
| Huckleberry                          | Fennel                        |
| Blueberry                            | Caraway seed                  |
| Cranberry                            | Coriander                     |
| (30) <i>The Olive Family</i>         | Anise seed                    |
| Olive                                | Dill                          |
| (31) <i>The Morning Glory Family</i> | (32) <i>The Mint Family</i>   |
| Yam                                  | Mint                          |
| Sweet Potato                         | Sage                          |
| (33) <i>The Potato Family</i>        | Savory                        |
| Irish potato                         | (34) <i>The Coffee Family</i> |
| Tomato                               | Coffee                        |
| Red and green peppers                | (35) <i>The Gourd Family</i>  |
| Eggplant                             | Squash                        |
| (36) <i>The Thistle Family</i>       | Pumpkin                       |
| Lettuce                              | Cucumber                      |
| Salsify (oyster plant)               | Cucumber pickle               |
| Endive                               | Watermelon                    |
| Chicory                              | Cantaloupe                    |
| Jerusalem artichoke                  | Muskmelon                     |
| Artichoke                            |                               |
| Dandelion                            |                               |

When the offending food is finally isolated, a new set of recipes must be followed, and vigilance must be maintained to prevent the ingestion of the food in some unsuspected form. Fortunately, many food manufacturers are stating accurately on food pack

ages the constituents making up the food. A number of milkless, eggless, wheatless suggestions and recipes are available (see Appendix), and with careful planning a fairly normal diet may be obtained for the victim of allergy, even though the sensitivities are several. During the use of elimination diets, care must be taken that nutritional deficiencies are met by vitamin and mineral supplementation. This is especially important when the patient is a child. It has been suggested by some that the patient should not remain on a single elimination diet longer than two weeks.

An alternate approach to the elimination diets has been proposed by Lee and Squier. They suggest, unless previous findings indicate otherwise, that a "provocative diet" be used in the recognition of food allergy. This constitutes a diet of wheat, milk, egg, beef, orange, and potato. Only these foods, which are the foods most often responsible for allergy, are given for about a week. If the patient is sensitive to any of these foods, it can probably be detected within this time. If there is no indication of a food allergy, then other foods can be added to this basic diet. It would seem that one of the advantages of this approach to the detection of food allergies is the flexibility and nutritional adequacy of the foods included in the test diet.

Frequently heating a food will alter its structure favorably. Many children who cannot drink raw, pasteurized or dried milk, can take boiled milk or evaporated milk. A person sensitive to corn may take corn syrup. Prolonged cooking or toasting of cereals and cereal products sometimes renders them nonreactive, where the usually prepared cereal would be.

A statement by Vaughan will serve as a summary. "The most successful therapeutic program in food allergy consists in (a) searching for and finding the offending allergens, (b) their elimination from the diet, (c) the providing of an adequate dietary program with substitute foods, (d) food additions as rapidly as the patient's tolerance will permit. When avoidance is impossible, desensitization, either orally or parenterally, may be attempted, although this method is usually not as successful. There is evidence that the natural tendency is toward loss of sensitization provided the tissue response is not repeatedly restimulated by recurrent exposure to the allergen. After sensitization has been lost, following avoidance, the patient often finds that he can again eat the offending food in moderation."

### Review Questions

- 1 What does the term allergy mean?
- 2 What are some of the symptoms of allergy?
- 3 Does food allergy indicate food poisoning?
- 4 What two treatments are used for allergy?
- 5 Is food allergy always caused by the ingestion of the offending food?
- 6 Is allergy an inherited characteristic? Explain.
- 7 What methods are used to diagnose an allergy?
- 8 What is the purpose of the Rowe elimination diets?
- 9 What diet regime is used by Altner?
- 10 What foods most frequently cause allergies?
- 11 How does Vaughan summarize a successful therapeutic program in food allergy?
- 12 Does a hypersensitive person remain so through life?

### Suggested Projects

- 1 Examine your own menus. How many times does wheat appear in one day? In what ways does wheat appear in the diet? How could you modify your menus to exclude wheat entirely from your food?
- 2 Examine menus as suggested in problem 1 but in reference to the milk consumption in the diet. If you were allergic to milk and milk products, calculate a diet pattern that would provide the nutrients normally supplied by milk. How difficult would this be to maintain in the daily diet?
- 3 Obtain some of the hypoallergic milks. Compare them in respect to taste, price, and ease of cooking with the usual cow's milk. If it were necessary for a family to use one of these milks for one member of the family, what are the difficulties which would ensue in the family meal service?
- 4 If you were allergic to wheat what would be your luncheon menu if you ate away from home? Would such a menu fit into your current food budget?

## CHAPTER 42

### SUMMARY OF DIET THERAPY

It is hoped that the foregoing pages have re emphasized the original premise stated—that the *diet in any clinical condition should and can be made by adjustments in the normal diet pattern*; that the body as a whole is more important than any individual part and it must not be sacrificed for any one dysfunction. A midcourse is frequently necessary for this end—concession to total body needs. For assurance of adequacy of a therapeutic diet, the final diet should be checked against the accepted standard requirements.

In Table 118 there is an outline indicating variations from the normal and in Table 119 these data are further summarized. Also see Table 3 for review of normal recommended allowances.

TABLE 118

NORMAL CONSTITUENTS AND VARIATIONS FROM THE NORMAL CONSTITUENTS  
OF THE DIET (ADULT)

Calories	35 to 100 calories per kilogram per 24 hours, depending upon age and activity, or the height in inches times 40 calories per inch with reasonable deviation for metabolic activity, physical activity, and desired weight <i>Increased</i> in malnutrition, end of pregnancy, fevers, when metabolic rate is elevated <i>Decreased</i> in obesity, usually in diabetes, hypertension, gout, arthritis, hypothyroidism
Protein	1 to 15 gm per kilogram for adult—10 to 15% of total calories, 2 to 3 gm per kilogram for growing child <i>Increased</i> in pregnancy, lactation, recovery from illness, malnutrition, when albuminuria is present and when serum proteins are low (nephrosis), in colitis, liver disease, typhoid, gastrointestinal tract disturbances, especially peptic ulcer and ulcerative colitis <i>Decreased</i> in acute nephritis and uremia, moderate intake (as with all food) in cardiac disease or hypertension In gout the diet should be low purine, therefore restriction of certain proteins (nucleoproteins)
Fat	1 to 2 gm per kilogram of body weight, 25 to 40% of total calories, a total of 75 to 150 gm in adult diet <i>Increased</i> in epilepsy, malnutrition, constipation, tuberculosis, urinary tract infections, in most high caloric diets, and in some diabetes and hypoglycemia <i>Decreased</i> in certain liver disturbances, celiac disease, steatorrhea, pancreatitis, anemia, decreased gastric motility

TABLE 118—CONT'D

Carbohydrate	4 to 5 gm per kilogram of body weight, 40 to 50% of the total calories. A total of 300 to 400 gm in adult diet. <i>Increased</i> in liver and gall bladder disease, cardiac disease, acute nephritis and uremia, all fevers except tuberculosis, nausea and vomiting, high caloric diets, to overcome intestinal putrefaction. <i>Decreased</i> in epilepsy or in the ketogenic diet, in tuberculosis, and in some diabetes and hypoglycemia.
When percentage distribution of calories is used instead of grams of nutrient per kilogram of body weight of individual, the value expresses the need for the child as well as the adult and properly fluctuates with the caloric change. These facts make the caloric ratio valuable as a calculating aid.	
Vitamins*	A—5 000 to 8 000 I U daily Thiamine—0.3 to 1.0 mg daily Riboflavin—0.4 to 2.5 mg daily Niacin—3 to 19 mg daily C—30 to 150 mg daily D—400 I U I, K, and other members of the B complex—requirement unknown. Specific vitamin therapy in the deficiency or subclinical conditions due to their lack. <i>Increased</i> general vitamin therapy in pregnancy, lactation, fevers or other conditions of metabolic increase, gastrointestinal disorders or lesions.
Minerals	Ca 0.8 to 2 gm P 1 to 1½ gm Fe 12 to 15 mg <i>Increased</i> in pregnancy and lactation, growth, and anemia. Alteration in intake of Na and K in Addison's disease. <i>Decrease</i> in K and increase in Na in Addison's disease, restriction of NaCl from usual 10 to 20 gm to maintenance level of 1 to 3 gm in edema. Acid base balance shift to combat urolithiasis or urinary tract infection.
Water	1 to 2 liters daily <i>Increased</i> in fevers, certain kidney disorders, dehydration, Addison's disease, constipation. <i>Decreased</i> in edema, renal insufficiency, epilepsy.
Indigestible fiber	<i>Increased</i> in atonic constipation and obesity. <i>Decreased</i> to produce smooth or soft diet for gastrointestinal lesions, spastic constipation, malnutrition, high caloric diets.
FA/G	Normal ratio 0.8/1, diabetes 1/1 borderline 1.5/1, ketogenic level 3/1.
Acid base balance	The normal diet is neutral or somewhat alkaline. The acidic diet is used to facilitate the solution of phosphates, while the basic or alkaline ash diet is effective when urates, oxalates or cystine tend to precipitate. Adjustments may also be of value in combating infections.

\*Refer to Table 3 for details of 1953 revision.

TABLE

## A SUMMARY OF MODIFICATIONS OF THE

	HIGH PROTEIN	LOW PROTEIN	HIGH CALORIE
<i>Milk, cheese</i>	1 qt milk, milk drinks, nonfat dry milk solids, all cheese	1 cup milk—all forms or $\frac{3}{4}$ oz cheddar cheese or equivalent amounts other cheese	1 qt milk, milk drinks, added non fat dry milk solids, all cheese
<i>Meat, fish, poultry, eggs</i>	6 to 8 oz. E.P. all meat, fish, poultry, 1 or more eggs	2 oz. E.P. all meat, fish, poultry 1 egg instead of 1 oz meat	6 to 8 oz. E.P. all meat, fish, poultry
<i>Bread, cereal, cereal products</i>	11 to 8 servings—preferably whole grain or enriched	4 servings—preferably whole grain or enriched	11 or more servings, preferably whole grain or enriched
<i>Potato</i>	1 serving—all potato	1 serving—all potato	1 or more servings—all potato
<i>Vegetable, green, leafy, or yellow</i>	1 or more servings—all vegetables, raw or cooked	1 serving—all vegetables raw or cooked	1 or more servings All vegetables, raw or cooked
<i>Vegetable, other</i>	1 or more servings of all vegetables, raw or cooked	2 servings of all vegetables, raw or cooked	1 or more servings—all vegetables, raw or cooked
<i>Fruit, citrus</i>	1 or more servings of all citrus fruits, as juice or as fruit	1 serving of all citrus fruits, as juice or as fruit	1 or more servings of all citrus fruits as juice or as fruit
<i>Fruit, other</i>	2 or more servings, as juice or fruit, raw, cooked, canned, or dried	2 servings, as juice or fruit, raw, cooked, canned, or dried	2 or more servings as juice or fruit, raw, cooked, canned, or dried
<i>Fats</i>	3 or more table spoons—all fats	3 or more table spoons—all fats	11 or more table spoons—all fats
<i>Miscellaneous</i>	All desserts, beverages, condiments, soups, sweets, pickles, relishes, spices, herbs, vinegar, white sauce	Coffee, carbonated beverages tea, most condiments, herbs, clear candy, jams, jellies, syrups, honey, vinegar, soups and desserts made with foods listed above	All desserts, beverages, condiments soups, sweets pickles relishes, spices herbs vinegar, white sauces In between feedings, emphasis upon evening snack

DA

## BASIC DIET TO MEET THERAPEUTIC NEEDS

LOW CALORIE	LOW FLEPH	HEARD
1 pt. milk, skim milk preferred, cottage cheese may be substituted	1 pt. or more milk, all forms, all cheese	1 pt. or more milk, milk drinks, cottage, cream, farmer cheese
6 oz. E.P. lean meat, fish, poultry, broiled or roasted, 1 egg poached, soft or hard cooked	Limited amounts of beef, veal, lamb, mutton, pork, pork products, game, fowl, fish, shellfish. (Others restricted (see below) 1 or more eggs	1 oz. or more E.P.; tender, well done, broiled or roasted meat, fish or poultry, whole or minced. Eggs poached, soft or hard cooked or scrambled in double boiler
4 or more servings, preferably whole grain or enriched	4 or more servings, preferably whole grain or enriched	4 or more servings toasted refined enriched bread; refined cereals, crackers from refined flour
Substitute 1 small baked potato for 1 serving of bread, etc	1 or more servings	1 or more servings mashed, baked (served without skin), boiled, scalloped, creamed
1 or 2 servings—all vegetables, raw or cooked	1 or 2 servings—all vegetables, raw or cooked. Limited amounts—aspargus, peas, spinach, string beans	1 or more servings cooked tender whole, or purée
1 or 2 servings—all vegetables other than those listed below	2 or more servings all vegetables, raw or cooked. Limited amounts—shell beans, lentils, mushrooms	2 or more servings cooked tender whole, or purée
1 or 2 servings of citrus fruit, as juice or as fruit	1 or more servings of citrus fruit, as juice or as fruit	1 serving strained dilute orange juice, other citrus juices as tolerated
1 or 2 servings as juice or fruit, raw or cooked, canned without sugar	2 or more servings as juice or fruit, raw, cooked, canned, or dried	1 or more servings cooked or canned without skins or seeds, puréed fruits, dried fruits
3 or more tablespoons—all fats	3 or more tablespoons—all fats	3 or more tablespoons cream, butter, fortified margarine
Clear coffee, tea, cereal beverages, unsweetened carbonated beverages, clear bouillon or consommé, spices, herbs, vinegar; condiments, pickles, relishes in limited amounts, artificial sweetener	All beverages, desserts, rich desserts in moderation, condiments, herbs, pickles, relishes, spices, nuts, all sweets	Tea and coffee as tolerated, desserts of gelatin, puddings, cream soups made with purée of vegetables; salt, white sauce; sugar in moderation



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<i>On</i>	therapeutic purposes	bread, cereal, cereal products, potato, vegetables, fruits, eggs, desserts and soups made from milk or eggs in addition to amounts above	therapeutic purposes
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119A—CONT'D

LOW CALORIE	LOW PURINE	BLAND
Additional amounts of food other than those listed above, sweets, as candy, sugar, jam, jellies, syrups, desserts, sauces, as Hollandaise, gravy, white sauce; foods preserved in oil; dried fruits; fried foods, high calorie vegetables as corn, lima beans, legumes; fruits preserved in sugar syrup	Meat extracts, broth, gravy; liver, kidney, sweetbreads, sardines, anchovies, her ring, mackerel, roe, seal lops, mussels, partridge, and squab; mincemeat; fried meat; fried potato, potato chips, alcohol, yeast	Fried potatoes, potato chips; tough, fibrous meats, fried and rare meats; meat extracts, broth, bouillon, gravy; fried eggs; strong flavored, highly seasoned, and American cheese; whole grain bread, cereal, cereal products; raw or tough fibrous vegetables; raw fruits or skins and seeds or fruits; carbonated beverages; sweets (other than above); nuts, alcohol, condiments, relishes, pickles, spices, vinegar; salad oils

TABLE

	LOW RESIDUE	HIGH RESIDUE
<i>Milk, cheese</i>	Cottage, cream cheese, American cheese used for flavoring	1 pt or more milk, milk drinks, all cheese
<i>Meat, fish, poultry, eggs</i>	4 oz or more E P, tender, well done broiled or roasted meat, fish, or poultry, whole or minced Eggs poached, soft or hard cooked, or scrambled in double boiler	4 oz or more E P; all meats, fish, poultry; 1 or more eggs
<i>Bread, cereal, cereal products</i>	4 or more servings, enriched white bread, refined cereals, crackers from enriched flour	4 or more servings, whole grain bread, cereal, cereal products
<i>Potato</i>	1 or more servings mashed, baked (served without skin), boiled, escaloped, creamed	1 or more servings, potato with skin
<i>Vegetable, green, leafy or yellow</i>	1 or more serving canned or cooked puree	1 or more serving all vegetables, one served raw
<i>Vegetable, other</i>	2 or more servings canned or cooked puree, vegetable juices	2 or more servings, all vegetables, one served raw
<i>Fruit, citrus</i>	1 or more servings strained citrus juice	1 or more servings of citrus fruit
<i>Fruit, other</i>	1 or more servings strained fruit juice, puréed, cooked or canned fruits, avocado, ripe banana, canned or cooked fruits without skins or seeds	1 or more servings, all fruits, raw, cooked, canned
<i>Fats</i>	3 or more tablespoons cream, butter, fortified margarine, vegetable oils	3 or more tablespoons—all fats
<i>Miscellaneous</i>	Tea, coffee, cereal beverage, carbonated beverage, broth, bouillon, clear candy, sugar, jelly, honey, syrup, gravy, salt, vinegar, spices without residue, angel food, sponge cakes, gelatin desserts, sherbets	All desserts, beverages, condiments, soups, sweets, pickles, relishes, spices, herbs, vinegar, white sauce

119B

SOFT—HIGH CALORIC	LOW SODIUM	LOW FAT
1 pt or more milk, milk drinks, all cheese (except those listed below)	1 pt milk or dried milk	1 pint milk, whole or skim, cottage cheese, cheese made from skim milk
4 oz or more EP tender, well done, broiled or roasted meats, fish, poultry, 1 or more eggs	4 oz EP, meat, fish, poultry (except those listed below), prepared without salt, 1 or more eggs poached, soft or hard cooked or scrambled in a double boiler	4 oz or more EP, lean meat, fish, poultry, broiled or roasted; 1 egg, poached, soft or hard cooked or scrambled in a double boiler
4 or more servings enriched white bread, refined cereals, crackers from refined flour	4 or more servings whole grain or enriched bread, cereal or cereal products, or same in low sodium foods	4 or more servings whole grain or enriched
1 or more servings mashed baked (served without skin), boiled, escalope, creamed	1 or more serving potato (except listed below) cooked without salt	1 or more serving, baked, mashed, or boiled
1 or more serving cooked tender, whole vegetables	1 or more serving all vegetables, raw or cooked, prepared without salt (except those listed below)	1 or more servings all vegetables, raw or cooked
2 or more servings cooked tender whole vegetables	2 or more servings all vegetables raw or cooked, prepared without salt (except those listed below)	2 or more servings, all vegetables, raw or cooked (except those listed below)
1 or more servings of citrus fruit, fruit juice	1 or more servings of citrus fruit fruit juice	1 or more servings of all citrus fruits as juice or fruit
1 or more servings, all fruits, cooked, canned	1 or more servings all fruits cooked canned (except those listed below), "gas forming" if tolerated	2 or more servings of all fruits as juice or fruit, raw cooked, canned, or dried
3 or more tablespoons— all fats	1 or more tablespoons cream sweet butter	2 tablespoons (more if tolerated) of butter, fortified margarine cream (20%) salad oil
All desserts (except those listed below), beverages soups sweets, white sauce	Desserts prepared from foods above without salt, cereal beverages coffee, tea, unsalted soup prepared from allowed foods, sugar pure sugar candy honey jam jelly or mar malade prepared without salt, chocolate herbs some spices, unsalted prepared foods	All beverages, gelatin desserts, ice cream, puddings in moderation, sherbet, angel food cake, clear candy honey, jam, jelly, molasses, sugar, herbs, salt vinegar, some spices

	LOW RESIDUE	HIGH RESIDUE
Omit	*Milk, milk drinks, cheese other than that listed above, tough, fibrous meats fried meats, fried eggs, whole grain bread, cereal, cereal products, raw fruits, fruits with skins and seeds, raw and cooked whole vegetables, desserts other than those listed above or prepared from foods other than those allowed, candy containing nuts, jams or marmalade, nuts, pickles, relishes, fried potato	Fruit and vegetable juices purée of fruit and vegetables

\*Some omit milk and milk drinks

119B—CONT'D

SOFT—HIGH CELLULOSIC	LOW SODIUM	LOW FAT
Highly seasoned, strong flavored cheese, raw fruits and vegetables, rich desserts, condiments, pickles, relishes, spices, herbs, vinegar	Bouillon, consommé, carbonated beverages, desserts made with baking powder, baking soda, quick cooking cereals, commercial gelatin desserts, milk other than listed above; lard, salted or smoked meats, fish or poultry, frozen and canned fish, canned meats and poultry, all cheese, shellfish, molasses, syrups, most dried fruits, frozen and canned vegetables, lettuce, celery, chard, dandelion greens, kale, spinach, relishes, condiments, pickles, salted nuts, olives, salt, some public water	Heavy cream, fried potato, fatty meats and fish, cheese other than listed above, foods canned in oil, desserts high in fats, avocado, raw apple, melon, chocolates, "gas forming vegetables" as those of the cabbage family, dried peas, rutabagas, turnips, dried beans

See text for details. In most cases, diets are calculated for individual patients and the degree of restriction will be varied. This is especially true in diets low in calories, protein, sodium and fat.

## PART IV

### QUESTIONS FOR GENERAL REVIEW

- 1 What is meant by the term metabolism?
- 2 Under what conditions is basal metabolism measured? Why?
- 3 Show by calculation your approximate caloric requirements?
- 4 What factors would influence this value?
- 5 What is the purpose of digestion?
- What are the end products of protein digestion?
- 7 What value would there be in having an analysis of the stool?
- 8 What role does the circulation of blood play in nutrition?
- What is meant by the term anemia?
- 10 Does any relationship exist between the mind and food utilization?
- 11 What influence do the endocrines exert on one's state of nutrition?
- 12 Name four endocrines
- 13 How are foods classified?
- 14 What is meant by the biological value of a protein?
- 15 Can proteins "supplement" one another? How?
- 16 Of what value is liver?
- 17 What direction should be given for its cooking? Why?
- 18 How much protein should the normal adult diet contain?
- 19 How many grams should a "high" protein diet contain?
- 20 How do light and dark fish differ in composition?
- 21 Name four conditions under which a high protein diet is advantageous
- 22 What is the nutritive value of milk?
- 23 How do cheese and milk compare in composition?
- 24 What is meant by the pasteurization of milk?
- 25 How should milk be handled in the home?
- 26 What is the nutritive difference between butter and margarine?
- 27 How does cooking alter starch?
- 28 How does the carbohydrate value vary in fruits and vegetables?
- 29 Do fruits and vegetables differ in nutritive value? Explain
- 30 What are the symptoms of vitamin A deficiency?
- 31 What is the "recommended allowance" for ascorbic acid for the normal individual?
- 32 Is this the same as the "minimum requirement"? Give reason for your answer
- 33 What is your approximate requirement for thiamine?
- 34 How might this be met?
- 35 What is the role of iron in the body?
- 36 What is the recommended allowance for calcium for a 1 year old child?
- 37 Is fluid intake important in health? Give reason for your answer

- 38 How accurately do tables of food composition indicate the nutritive value of foods?
- 39 What factors influence the nutritive value of vegetables?
- 40 Do you consider a nutrition history of value? Why?
- 41 List the Basic Seven food groups and indicate the composition and value of each group
- 42 Are proteins and carbohydrates incompatible in the diet? Give reason for your answer
- 43 Of what value are nuts in the diet?
- 44 Outline a daily dietary pattern for yourself
- 45 How would you alter this to bring about weight loss?
- 46 What are the dangers and disadvantages of obesity?
- 47 How is obesity measured in the individual?
- 48 How can you approximately determine your desirable weight?
- 49 How rapidly should weight be lost? Why?
- 50 Suggest measures whereby you may increase your diet by 1,000 calories daily
- 51 Could a vegetarian diet be adequate? Explain
- 52 What adjustments should be made in the diet during pregnancy? Why?
- 53 Would the diet for pregnancy be adequate for lactation?
- 54 How would you calculate the formula for a baby weighing 8 pounds?
- 55 Outline a diet which might be served to a 9 month old baby
- 56 How does the diet of a 2 year old child differ from that of an adult?
- 57 Can dental caries be influenced by diet? Give reason for your answer
- 58 How would the diet of a man 85 years old differ from the diet of one 35?
- 59 What factors should be considered in planning the diet for an older person?
- 60 How could the normal diet be modified to become a bland diet?
- 61 What are the characteristics of a bland diet?
- 62 Differentiate between a liquid a soft and a regular diet
- 63 Upon what principle is the diet for the diabetic based?
- 64 How might the written prescription in terms of grams of P F and C differ for the diabetic and the normal individual if both had a need for 3 000 calories daily?
- 65 Would the type of insulin used alter the diet pattern? How?
- 66 What are the characteristics of the diet in celiac disease? If bananas are used why should they be fully ripe?
- 67 How may hypoglycemia be treated by diet?
- 68 What restrictions might be made in the diet of the patient with gout?
- 69 What organ dysfunction is associated with Addison's disease?
- 70 What types of disorders occur along the gastrointestinal tract?
- 71 How could these affect the food intake?
- 72 What specific instructions should be given a gastric ulcer patient?
- 73 What is the diet currently used for liver disorders?
- 74 Is a low or high protein diet indicated in albuminuria? Give reason.
- 75 What are renal calculi?



- 76 What is meant by the "rice diet"?
- 77 What are the outstanding features of the low sodium diet?
- 78 Why is this type of diet sometimes used?
- 79 How does the low sodium diet differ from the low salt diet?
- 80 What foods should be emphasized in anemia?
- 81 What effect does fever have on the need for food?
- 82 What is meant by a ketogenic diet? How could a diet be altered to bring this about?
- 83 What foods are frequently associated with allergy?
- 84 What are elimination diets?
- 85 What precautions must be taken in planning the diet for allergy?
- 86 Name three skin disorders which result from food deficiencies?
- 87 What are the characteristics of pellagra?
- 88 Is this condition curable? Give reason for your answer.
- 89 What is meant by a subclinical deficiency?
- 90 How may they be detected?
- 91 Name three factors that might alter food needs?
- 92 Are data on the cholesterol content of foods ever of value? Give reason for your answer.
- 93 What factors other than food and physical defects influence health?
- 94 How would you explain an apparent food deficiency in a person consuming an apparently adequate diet?
- 95 Do you consider nutrition a "pure science"? Give reason for your answer.
- 96 What precautions must be taken in the cooking of protein food?
- 97 Suggest a menu which might be tray served to a woman 60 years old who is not acutely ill and has no need for an adjusted diet.
- 98 Outline a diet for a patient who underwent an operation for colostomy a month ago.
- 99 What general directions should be followed in preparing a tray?
- 100 What knowledge has been gained in this course which can be practically applied to your own life?

## PART V

### REFERENCES

#### *Abbreviations for Journals Cited*

Agricultural Experiment Station Bulletin	Agrie Exper Sta Bull
American Journal of Digestive Diseases	Am J Digest Dis
American Journal of Diseases of Children	Am J Dis Child
American Journal of the Medical Sciences	Am J M Sc
American Journal of Physiology	Am J Physiol
American Journal of Public Health	Am J Pub Health
Annals of Allergy	Ann Allergy
Annals of Internal Medicine	Ann Int Med
Archives of Internal Medicine	Arch Int Med
Archives of Pediatrics	Arch Pediat
Journal of the American Dietetic Association	J Am Dietet A
Journal of the American Medical Association	J A M A
Journal of Biological Chemistry	J Biol Chem
Journal of Clinical Investigation	J Clin Invest
Journal of Clinical Nutrition	J Clin Nutrition
Journal of Dairy Science	J Dairy Sc
Journal of Experimental Education	J Exper Educ
Journal of Experimental Medicine	J Exper Med
Journal of Nutrition	J Nutrition
Journal of Pediatrics	J Pediat
Medical Clinics of North America	M Clin North America
New England Journal of Medicine	New England J Med
Nutrition Reviews	Nutrition Rev
Physiological Reviews	Physiol Rev
Quarterly Journal of Medicine	Quart J Med
Scientific Monthly	Scient Month
Western Journal of Surgery	West J Surg

#### *Allergy*

- Alvarez W C and Hinslaw H C Foods That Commonly Disagree With People J A M A 104 2053 1935
- Conrad Marion Allergy Cooking A Guide With Menus and Recipes, New York 1943 Thomas Crowell Co
- Glaser Jerome Pediatric Allergy A Critical Review of Recent Literature Ann Allergy 6 178 1948
- Morgan Helen You Can't Eat That, New York 1939, Harcourt, Brace and Company
- Howe Albert H Elimination Diets ed 2 Philadelphia 1944, Lea & Febiger
- Vaughan Warren T Primer of Allergy ed 13 St Louis 1953 The C V Mosby Company rev by J Harvey Black

#### *Anemia*

- McKibbin John M, and Stare, Frederick J Nutrition in Blood Regeneration J Am Dietet A 19 311, 1943
- Meyer Leo M McJurney, Robert and Ritz Norton D Intravenous Treatment of Pernicious Anemia With Vitamin B<sub>12</sub> J Clin Nutrition 1 219 1953

Minot, G R The Anemias of Nutritional Deficiency, J A M A 105  
1176, 1935

Wintrobe, M M Clinical Hematology, ed 3, Philadelphia, Lea & Febiger

### *Circulatory Diseases*

- Chapman, Carlton B Dietary Factors in Treating Heart Disease, J Am Dietet A 29 346, 1953
- Gofman, John W, and others Relation of Fat and Calorie Intake to Atherosclerosis, J Am Dietet A 25 317, 1954
- Grollman, Arthur Sodium Restriction as a Dietary Measure in Hypertension J Am Dietet A 22 864, 1946
- Landowne, Milton The Low Sodium Diet in Vascular Diseases, J Am Dietet A 24 187, 1948
- Page, Irvine H, and Corcoran, A C The Dietary Treatment of Hypertension, J Clin Nutrition 1 7, 1952
- Payne, Alma Smith, and Callahan, Dorothy Low Sodium Cook Book Boston, Little, Brown & Company (also available from Sun-kist Growers)
- Newburgh L H and Reimer, Ann The Rationale and Administration of Low Sodium Diets, J Am Dietet A 23 1047, 1947
- Wakerlin, G E Nutrition in Relation to Disease of the Heart and Blood Vessels, J Am Dietet A 26 417, 1950

### *Diabetes Mellitus*

- Allan Frank N History of the Treatment of Diabetes, J Am Dietet A 6 1, 1930
- Beck, Franklin P and Kirtley, W R Newer Insulins With Special Reference to NPH Insulin, New York J Med 50 2182 1950
- Caso, Elizabeth K, and others Calculation of Diabetic Diets Report of Joint Committee of J Am Dietet A, Am Diab A, and U S Pub Health Serv, J Am Dietet A 26 575, 1950
- Diabetes Number Am J Digest Dis 13 127, 1946
- Geiger, E Nutritional Problems Connected With Diabetes Mellitus, J Am Dietet A 23 905, 1952
- Guest, George M Unrestricted Diet in the Treatment of Juvenile Diabetes, J Am Dietet A 23 299, 1947
- Joslin, E P Diabetic Manual, Philadelphia, 1953, Lea & Febiger
- Joslin, E P Development of the Present Treatment of Diabetes J Am Dietet A 25 213, 1949
- White, Priscilla Free vs Controlled Regime in Juvenile Diabetes J Am Dietet A 25 757, 1949
- Wilder, Russell M A Primer for Diabetic Patients, ed 9, Philadelphia, 1950, W B Saunders Company

### *Diet Planning*

- Alexander, Lucy M, and Yeatman, Fanny Walker Meat for Thrifty Meals, Farmers' Bulletin No 1908, U S Department of Agriculture Superintendent of Documents, U S Government Printing Office Washington, D C
- Bergen County Demonstration Office, Low Cost Adequate Diets, Hackensack, New Jersey
- Community Health Association of Boston, Low Cost Food for Health 1937
- Family Fare, Home and Garden Bulletin No 1, U S Department of Agriculture, Bureau of Human Nutrition and Home Economics, December, 1950, Washington D C
- A Fruit and Vegetable Buying Guide, for Consumers, Miscellaneous Publication No 167, 1948, U S Department of Agriculture, Washington, D C

- Hambridge, Gove Your Meals for Your Money, New York, 1936, McGraw Hill Book Co, Inc
- Leichsenring, Jane M, and Wilson Eva Donelson Food Composition Table for Short Method of Dietary Analysis (2nd rev), J Am Dietet A 27 386, 1951
- Monroe Day, and Henry, Mary It Pays to Buy Food Wisely, Ithaca, New York, Cornell Bull No 237
- Monroe, Day, and Henry, Mary Low Cost Food for Health, Ithaca, New York, Cornell Bull No 236
- Remington, Joe The Social Origin of Dietary Habits, Scient Month, Sept, 1936
- Rountree Jennie L This Problem of Food, 1940 Public Affairs Committee, Inc 30 Rockefeller Plaza Pamphlet No 30
- Stielling Hazel, and Ward Medora Diets at Four Levels of Nutritive Content and Cost, U S Department of Agriculture, Circular No 296
- University of Illinois Low Cost Diet for Emergency Use, Circular No 406
- Visiting Nurse Association of Brooklyn, New York, 138 South Oxford St, Brooklyn 17 Eating Can Be Fun for Little as Well as Big Children
- Woods Bertha Foods for the Foreign Born in Relation to Health, Boston, 1923, Whitecomb and Harrows

### *Diet Therapy*

- Barborka, Clifford J, Treatment by Diet ed 5, Philadelphia, 1949, J B Lippincott Company
- Duncan, Garfield G Diseases of Metabolism, ed 3, Philadelphia, 1952, W B Saunders Company
- Hawley, Estelle I and Maurer Max Father The Fundamentals of Nutrition, ed 3, Springfield, 1949, C C Thomas
- Johns for the Clinician, ed 5, Philadelphia
- McLes J Nutrition and Diet in Health 1952 W B Saunders Company
- Pollack, Herbert, and Halpern Seymore L Therapeutic Nutrition, Food and Nutrition Board Publication No 234 1952
- Proudfit Fairfax T, and Robinson Corinne H Nutrition and Diet Therapy, ed 10 New York 1950 The Macmillan Company
- Stern, Frances Applied Dietetics, ed 3, edited by Helen Rosenthal and others, Baltimore 1949 Williams and Wilkins Company
- Turner Dorothea Handbook of Diet Therapy, Chicago ed 2, 1952, The University of Chicago Press
- Wohl, Michael G Dietotherapy, Philadelphia 1945, W B Saunders Company

### *Digestive Tract*

- Andersen Dorothy H Celiac Syndrome, J Pediat 30 564 1947
- Andersen, Dorothy H Dietary Therapy for Congenital Pancreatic Deficiency, Am J Dis Child 70 100 1945
- Andresen, Albert F Dietary Principles in the Treatment of Gastrointestinal Diseases Am J Digest Dis 4 1 1937
- Barker, W Halsey Sprue M Clin North America 27 451, 1943
- Bond, F D Psychiatric Contributions to the Study of the Gastrointestinal Tract Am J Digest Dis 5 482, 1938
- Cheney, Garnett Anti Peptic Ulcer Dietary Factor, J Am Dietet A 26 668, 1950
- Johnson Doris The Bland Diet in Ulcer Therapy, J Am Dietet A 23 686, 1947

- Kantor, J L, and Kasich, A M. *Handbook of Digestive Diseases*, ed 2, St Louis, 1949, The C V Mosby Company
- Kirsner, Joseph B, Brandt, Minnie B, and Sheffner, A Leonard. Diet and Amino Acid Utilization in Gastrointestinal Disorders, *J Am Dietet A* 29 1103, 1953
- Marshall, E A. Unlimited Diet in Peptic Ulcer—One Thousand Cases, *Ohio M J* 49 1085, 1953
- May, C S, McCreary, J F, and Blackfan, K D. Notes Concerning the Cause and Treatment of Celiac Disease, *J Pediat* 21 289, 1942
- McKhann, Charles F, Spector, Samuel, and Meserve, Emily R. An Association of Gastrointestinal Allergy With the Celiac Syndrome, *J Pediat* 22 362, 1943
- Morgan, J W. The Harmful Effects of Mineral Oil Purgatives, *J Am Dietet A* 117 1335, 1941
- Rehfuess, Martin E. *Indigestion Its Diagnosis and Its Management*, Philadelphia, 1943, W B Saunders Company
- Rossett, N E, and others. Peptic Ulcer Medical Cure by Efficient Gastric Acid Neutralization, *Ann Int Med* 36 98, 1952
- Walters, W, and Snell, A M. *Diseases of the Gallbladder and Bile Ducts*, Philadelphia, 1940, W B Saunders Company
- Wilbur, Dwight L. The Role of the Gastrointestinal Tract in Conditioning Deficiency Diseases, *M Clin North America* 27 519, 1943
- Woods, Ruth. Nutritional Factors in Liver Disease, *Borden's Rev Nutrition Res*, vol 8, Dec, 1947

### *Feeding of Infants and Children*

- Aldrich, C Anderson, and Aldrich, Mary M. *Feeding Our Old fashioned Children*, New York, 1947, The Macmillan Company
- Arlitt, Ada Hart. *Psychology of Infancy and Early Childhood*, ed 3, University of Cincinnati, 1946, McGraw Hill Book Company, Inc
- Baby's Daily Time Cards, Federal Security Agency, Social Security Administration, U S Children's Bureau
- Bruch, Hilde. *Don't Be Afraid of Your Child*, New York, 1952, Farrar, Straus, and Young
- Bundeson, Herman N. *The Baby Manual*, New York, 1944, Simon & Schuster, Inc
- Gesell, Arnold, and Ilg, Frances L. *Feeding Behavior of Infants*, Philadelphia 1937, J B Lippincott Company
- Gesell, Arnold and Ilg, Frances L. *The Child From One to Ten* ed 4 New York, 1946, Harper & Brothers
- Ilg, Frances L. The Child's Idea of What and How to Eat, *J Am Dietet A* 24 658, 1948
- Infant Care, Publication 8, Federal Security Agency, Social Security Administration U S Children's Bureau
- Jackson, R L. Nutritional Management of Infants and Children, *Post grad Med* 9 472, 1951
- Jeanes, Phillip, C. *Feeding of Healthy Infants and Children*, chap XIV, in *Handbook of Nutrition*, American Medical Association, Philadelphia, 1951 The Blakiston Company
- Jeanes, Phillip C, Wright, Howard F, and Blake, Florence G. *Essentials of Pediatrics* ed 5, Philadelphia, 1954, J B Lippincott Co
- Kruse, H D, and others. Principles Underlying Studies of Nutrition Pertaining to the Influence of Supplements on Growth, Physical Fitness and Health (Report of the Committee on Diagnosis and Pathology of Nutritional Deficiency), *N R C, Arch Int Med* 74 258 1944
- Leamy, Catherine. *The Nutrition of Mothers and Children*, *J Home Econ* 45 25, 1953

- Everton, R M, and Clark, G Meat in the Diet of Young Infants, *J A M A* 134 1215, 1947
- Irvine, Milton J A Modern Concept of Breast Feeding, *J Pediat* 38 472, 1951
- Irvine, S Z Protein Nutrition in Pediatrics, *J A M A* 128 283, 1945
- Lynch, H D, and Snively, W D Modern Infant Feeding A Simplified Approach *J Indiana M A* 44 749, 1951
- Manual of Child Psychology, Edited by Leonard Carmichael Contributors John I Anderson and others, New York, 1946, John Wiley & Sons, Inc
- Martin, Ethel Austin Roberts Nutrition Work With Children, Chicago, 1954, University of Chicago Press
- Marriott, William McKim Infant Nutrition, ed 4, revised by P C Jeans, St Louis, 1947, The C V Mosby Company
- Meredith Howard A Physical Growth Record for Use in Elementary and High Schools Am J Pub Health 36 672 1946
- Ral to Meet Their
- Law growth and Development of the Young Child, ed 3, Philadelphia, J B Lippincott Company
- Roberts, Lydia J The Road to Good Nutrition, Pub 270 Federal Security Agency Social Security Administration, U S Children's Bureau 1947
- Sachs, Hille So Your Child Won't Fat, New York, 1951, Sterling Publishing Company
- Stuart, Harold C Children's Nutritional Needs During Growth and Development *J Am Dietet A* 24 934 1949
- Stuart, Harold C and Meredith Howard V The Use of Body Measurements in the School Health Program, *Am J Pub Health* 36 1367, 1946
- Tenney, H Kent Let's Talk About Your Baby, ed 3, Minneapolis, 1947, University of Minnesota Press
- Wetzel, N C A New Method for Evaluation *J A M A* 116 1197, 1941
- Wetzel, N C Assessing the Physical Condition of Children, *J Pediat* 22 323 1943
- Your Child From One to Six Pub 30 1945 Federal Security Agency, Social Security Administration, U S Children's Bureau

### Peters

- Coleman, W The High Caloric Diet in Typhoid Fever, *Am J M Sc* 143 77 1912
- Co Tui N Kuo H and Schmidt I The Protein Status in Pulmonary Tuberculosis *J Clin Nutrition* 2 252 1954
- Getz, Horace R Feeding the Tuberculosis Patient, *J Am Dietet A* 30 17, 1954
- Rhoads, Jonathan B Dietary Requirements of Acutely Ill Patients, *J Am Dietet A* 29 817, 1953

### Food Fads

- Bogert, I Jean Nutrition and Physical Fitness ed 6, Philadelphia, 1954, W B Saunders Company (chapter on Food Fads and Fancies)
- Carlson, A J Facts and Fancies About Food Fads, *Am J Pub Health* 31 1181 1941
- McCray, Doris W Food Fads Fallacies and Facts, *Hygeia* 20 48, 1942
- Miller, Elma, and Brown, Friede F Facts About Foods and Nutrition, Utah State Agricultural College Extension Bulletin No 226

- Mitchell, Helen S, and Cook, Gladys M Facts, Fads and Frauds in Nutrition, Massachusetts Agric Exper Sta Bull, 1937, p 343
- Nutritive Value of Black Strap Molasses, editorial in J A M A, J Am Dietet A 27 868, 1951
- Rose, Mary Swartz Belief in Magic J Am Dietet A 8 489, 1933
- Walker, George A, and Saltzman, Eleanor False Health Notions, Hygeia 20 32, 1941
- Youth, Beauty, and Yogurt, J Am Dietet A 27 581, 1951

### *Food Preparation and Meal Planning*

- American Dietetic Association, A Manual for Teaching Dietetics to Student Nurses, Philadelphia, 1949, W B Saunders Company
- American Home Economics Association, Terminology Used in Food Preparation, Washington, 1954
- Barber, Edith M Edith Barber's Cook Book, New York, 1940, G P Putman's Sons
- Farmer, Fannie Merritt The Boston Cooking School Cook Book, ed 7, Boston, 1945, Little, Brown, and Company
- Fleck, Henrietta A Recipe Primer, Boston, 1949, D C Heath and Company
- Fitch, Charlotte A, and Francis, Natalie K Food Principles of Cookery, New York, Prentice Hall, Inc
- Halliday, Evelyn G, and Noble, Isabelle T How's and Why's of Cooking rev ed, Chicago, University of Chicago Press
- Rombauer, Irma S The Joy of Cooking, Philadelphia, 1946, The Blakiston Company
- Sweetman, Marion and MacKellar, Ingeborg Food Selection and Preparation, ed 4, New York, 1954, John Wiley & Sons, Inc

### *Geriatrics*

- American Dietetic Association, Eating Is Fun for Older People Too, 1953, Chicago, Ill
- Carlson, A, and Stieglitz, E Physiological Changes in Aging, Ann Polit & Soc Services 279 18, 1952
- Donahue, Wilma T Psychologic Aspects of Feeding the Aged, J Am Dietet A 27 461, 1951
- Fact Book on Aging, Committee on Aging and Geriatrics, Federal Security Agency, Washington, D C
- Freeman, Joseph T Clinical Correlations in Geriatric Nutrition, Am J Clin Nutrition 1 446, 1953
- Horwitt, M K Dietary Requirements of the Aged, J Am Dietet A 29 443, 1953
- Stieglitz, E J The Second Forty Years, rev ed, Philadelphia, 1952, W B Saunders Company
- Stieglitz, E J Nutrition Problems of Geriatric Medicine in Handbook of Nutrition, of the American Medical Association, Philadelphia 1951, The Blakiston Company, chap XVI, p 327
- Thewlis, M W The Care of the Aged, ed 5, St Louis, The C V Mosby Company
- Tuohy, E L Geriatrics The General Setting, Geriatrics 1 17, 1946
- Walker, Vera W Dietotherapy Man, His Nutrition, and His Years, Am J Clin Nutrition 1 552, 1953

### *Gout*

- Hench, Phillip E Diagnosis and Treatment of Gout and Gouty Arthritis, J A M A 116 453, 1941
- Irvine, Rachmiel, Dietotherapy in Gout, J Am Dietet A 29 441, 1953

## *Historical*

- Gilson, Helen Some Historical Notes on the Development of Diet Therapy, *J Am Dietet A* 23 761, 1947
- Lusk, Graham Hist (Barker), New York 1 Metabolism
- McCay, Clive M, and Progress in Nutrition, *J Am Dietet A* 24 104, 1948
- Robinson Corinne H, and Proudfit, Fairfax J Development of Positive Food Therapy, *J Am Dietet A* 25 407, 1949
- Sherman Henry C The Nutritional Improvement of Life, New York, 1950, Columbia University Press

## *Hyperinsulinism and Hypoglycemia*

- Beeuwkes Adelia M The Dietary Treatment of Functional Hyperinsulinism *J Am Dietet A* 18 731, 1942
- Conn, J W The Advantages of a High Protein Diet in the Treatment of Spontaneous Hypoglycemia Preliminary Report, *J. Clin Invest* 15 673, 1936
- Conn, J W The Dietary Management of Spontaneous Hypoglycemia, *J Am Dietet A* 23 108, 1947
- Harris Seale The Diagnosis and Treatment of Hyperinsulinism, *Ann Int Med* 10 514 1936
- Symposium—Hypoglycemia *Internat M Digest* 37 376, 1941
- Wilder, R M Hyperinsulinism *J Clin Endocrinol* 1 593, 1941

## *Journals With Which All Students of Nutrition Should Be Familiar*

- American Journal of Clinical Nutrition
- American Journal of Diseases of Children
- Annals of Internal Medicine
- \*Borden's Reviews
- \*Hygeia
- Journal of Home Economics
- \*Journal of the American Dietetic Association
- \*Journal of the American Medical Association
- Journal of Nutrition
- \*Journal of Pediatrics
- \*Nutrition Reviews

## *Kidney and Urinary Tract*

- Boyle, H H, and Herlert, H J Chronic Nephritis and Nephrosis in Children, *M Clin North America* 34 71, 1950
- Calvin, J K Acute Glomerulonephritis *M Clin North America* 34 95, 1950
- Higgins, C C Urinary Lithiasis, *J Urol* 36 168, 1936
- Kagan, B M, and others Serum Vitamin A and Total Plasma Lipid Concentrations as Influenced by the Oral Administration of Vitamin A to Children With the Nephrotic Syndrome, *J Clin Invest* 29 141, 1950
- Kempner, W Treatment of Heart and Kidney Disease and of Hypertensive and Arteriosclerotic Vascular Disease With the Rice Diet, *Ann Int Med* 31 821 1949

\*Those probably most useful to the student



*Metabolism*

- Boothby, W M, and Sandiford, Irene Basal Metabolism, *Physiol Rev* 4 69, 1924
- Butt, Hugh R, and Leary, William V Diseases of Metabolism, Review of Certain Recent Contributions, *Arch Int Med* 67 411, 1941
- Carpenter, Thorne M The Historical Development of Metabolism Studies, *J Am Dietet A* 25 837, 1949
- DuBois, Eugene F Basal Metabolism in Health and Disease, Philadelphia, 1936 Lea & Febiger
- Duncan, Garfield G Diseases of Metabolism, ed 3, Philadelphia, 1951 W B Saunders Company
- Murlin John R Normal Processes of Energy Metabolism, Endocrinology and Metabolism (Barker), New York, 1922, D Appleton Company, vol 3

*Minerals*

- Grace, William J, and others Absorption of Iron From the Gastrointestinal Tract, *J Clin Nutrition* 2 162 1954
- Johnston Frances A Iron Needs of Children, *J Am Dietet A* 29 758 1953
- McCollum, E V Early Speculations on the Significance of Phosphorus in Nutrition, *J Am Dietet A* 27 650, 1951
- Sherman, Henry C Calcium and Phosphorus in Foods and Nutrition New York, 1948, Columbia University Press
- Vallee, Bert L Trace Elements in Biochemistry and Nutrition *Nutrition Revs* 10 65, 1952
- Woods, Ruth The Calcium Requirement of Adults, *Borden's Rev Nutrition Res*, vol 9, Nov, 1948

*Miscellaneous References*

- Calorie Requirements Report of the Committee on Calorie Requirements, Food and Agriculture Organization of the United Nations, June 1950
- Cameron, Edwin J Food Protection and Canned Foods, *J Am Dietet A* 29 670, 1953
- Cecil, Russell L Textbook of Medicine, ed 8, New York, 1951, W B Saunders Company
- deCastro, Josue The Geography of Hunger, Boston, 1952, Little, Brown and Company
- Dietary Surveys, Their Techniques and Interpretation, Food and Agriculture Organization of the United Nations, 1949
- Inadequate Diets and Nutritional Deficiencies in the United States, Bulletin No 109, National Research Council, Nov, 1943
- Janssen, Wallace F The Law Behind the Label, *J Am Dietet A* 28 609 1952
- Kellogg, Charles E Food, Soil and People, United Nations Educational, Scientific, and Cultural Organization, New York, Manhattan Publishing Company
- Krohowski, Stefan Distribution of the World's Food United Nations Educational, Scientific, and Cultural Organization, New York, Manhattan Publishing Company
- Macy, Icie G, and others The Composition of Milks, Revised, 1953, Publication No 254 National Research Council 1953
- Manual for the Study of Food Habits, National Research Council Bulletin No 111, January, 1945

- Mayer Andre Food and Social Progress, United Nations Educational, Scientific and Cultural Organization, New York, Manhattan Publishing Company
- Mead Margaret Food and the Family, United Nations Educational, Scientific, and Cultural Organization New York, Manhattan Publishing Company
- Mead Margaret Cultural Patterns and Technical Change, United Nations Educational, Scientific, and Cultural Organization, 1953
- Nutrition Surveys Their Techniques and Value, Bulletin No 117, of the National Research Council, May, 1949
- Second World Food Survey, Food and Agriculture Organization of the United Nations Rome November, 1952
- Sternan Henry C, and Gettler, A O The Balance of Acid Forming and Base Forming Elements in Foods J Biol Chem 11 323, 1912
- Sherman Henry C Food Products ed 4 New York, 1948, The Macmillan Company
- Sutton Richard C Jr Diseases of the Skin, ed 11, in preparation, St Louis, The C V Mosby Company
- Synthetic Fats Food and Agriculture Organization of the United Nations, March 1949
- The Problem of Changing Food Habits Bulletin No 108, National Research Council October 1943
- Winslow C F A The Cost of Sickness and the Price of Health, World Health Organization Monograph Series No 7, 1951

### *Nutrition in General*

- American Medical Association Handbook of Nutrition A Symposium, ed 2 New York Philadelphia and London 1951, The Blakiston Company
- Balcock Charlotte G Food and Its Emotional Significance, J Am Dietet 24 300, 1948
- Bogert, I Jean Nutrition and Physical Fitness ed 6, Philadelphia, 1954 W B Saunders Company
- Brook, J F, and Autret M Kwashiorkor in Africa World Health Organization Series No 8 1952
- Bureau of Home Economics, United States Department of Agriculture Planning Diets by the New Yardstick of Good Nutrition, July, 1941
- Deuel Harry J Non Caloric Functions of Fat in the Diet, J Am Dietet A 26 253 1950
- Felvehjem C A Biological Significance of Nutrients, M Clin North America 27 277, 1943
- Enrichment of Flour and Bread A History of the Movement, Bulletin No 110 National Research Council November 1944
- Eppright, F S Factors Affecting Food Acceptance J Am Dietet A 23 579 1947
- Fleck Henrietta and Munves Elizabeth D Everybody's Book of Modern Diet and Nutrition New York 1955 Dell Publishing Company
- Galdston Iago Nutrition From the Psychiatric Viewpoint, J Am Dietet A 28 405 1952
- Gastineau Edwin J Stress and Nutrition J Am Dietet A 28 66C, 1953
- Gerard, Ralph W (ed) Food for Life Chicago, 1952, University of Chicago Press
- Gillett, Lucy H Nutrition in Public Health Philadelphia, 1946, W B Saunders Company
- Ginsberg Sol Winer The Psychological Aspects of Eating, J Home Econ 44 325, 1952

- Graubard, M. *Man's Food Its Rhyme or Reason*, New York, 1943, The Macmillan Company
- Hawley, Estelle E., and Mauer Mast, Esther. *The Fundamentals of Nutrition*, Springfield, Ill., 1940, Charles C Thomas
- John Hancock Life Insurance Company, *Life Conservation Series*, Boston, Mass
- Jolliffe, Norman, and others. *Clinical Nutrition*, New York, 1950, Paul B Hoeber, Inc.
- Jolliffe, Norman, and Smith, James J. *Nutrition in the Practice of Medicine*, *M Clin North America* 27 567, 1943
- King Charles Glen. *Basic Research and Its Application to the Field of Clinical Nutrition*, *J Clin Nutrition* 1 1, 1952
- Kilander, Holger Frederick. *Nutrition for Health*, New York, 1951, McGraw Hill Book Company, Inc
- Leichsenring, Jane M., and Wilson, Eva Donelson. *Food Composition Table for Short Method of Dietary Analysis* (2nd rev.), *J Am Dietet A* 27 386, 1951
- Levertov, Ruth M. *Food Becomes You*, Lincoln Nebraska, 1952, University of Nebraska Press
- Macy, Icie G., and Williams, Harold H. *Hidden Hunger*, Lancaster, Pa., 1945, The Jacques Cattell Press
- Manual of Applied Nutrition*, Dietary Department, The Johns Hopkins Hospital, Baltimore, Johns Hopkins Press
- Mayer Jean. *Food Composition Tables and Assessment of the Caloric Content of Diets*, *J Am Dietet A* 28 308, 1952
- McCollum, E V., and Becker, J E. *Food Nutrition and Health*, ed 6, Baltimore 1948, East End Post Station
- Metropolitan Life Insurance Company, *Health Literature, Home Nursing and Family Health and Safety Series*, New York City
- Mitchell, H H., and Hamilton T S. *The Effect of Different Grades of Cocoa Upon the Retention of Dietary Calcium by Growing Rats*, *J Nutrition* 31 377, 1946
- Mitchell, H H., and Smith, Janice M. *The Effect of Cocoa Upon the Utilization of Dietary Calcium*, *J A M A* 129 871, 1945
- Mueller W S., and Cooney, M E. *The Effect of Cocoa Upon the Utilization of the Calcium and Phosphorus in Milk*, *J Dairy Sc* 26 951, 1943
- Newburgh, L H., Johnston, W W., and Newburgh, I D. *Some Fundamental Principles of Metabolism*, Ann Arbor, Mich., 1945, Edwards Brothers
- Okey, Ruth. *Use of Food Cholesterol in the Animal Body*, *J Am Dietet A* 30 231, 1954
- Present Knowledge in Nutrition*, The Nutrition Foundation, Inc., New York 1953
- Proceedings of National Food and Nutrition Institute December, 1952* U S Department of Agriculture, *Agriculture Handbook No 56*, Washington D C
- Recommended Dietary Allowances*, Revised, 1953 A Report of the Food and Nutrition Board, National Research Council Publication No 302
- Ritchie, Jean A E. *Teaching Better Nutrition*, Food and Agriculture Organization Nutritional Studies No 6, of the United Nations, November 1950
- Robinson, Henry Morton. *Riddle of the Lymph*, *Hygeia* 25 688, 1947
- Selling, Lowell S., and Ferraro Mary Anna S. *The Psychology of Diet and Nutrition*, New York, 1945, W W Norton and Company, Inc
- Sherman Henry C. *Chemistry of Food and Nutrition*, ed 8, New York, 1952, The Macmillan Company
- Sherman, Henry C., and Lanford, Caroline. *Essentials of Nutrition*, ed 3, New York, 1951, The Macmillan Company

- Sherman, Henry C. *Food: Their Value and Management*, New York, 1946, Columbia University Press.
- Sherman, Henry C. *The Science of Nutrition*, New York, 1943, The Columbia University Press.
- Taylor, C. M., and Maelcol G. *Lowe's Laboratory Handbook for Dietetics*, ed 5, New York, 1949, The Macmillan Company.
- Turrer, C. I. *Personal and Community Health*, ed 9, St. Louis, 1952, The C. V. Mosby Company.
- White, Grace. *The Patient as the Focus of Attention*, *I Am Dietet* A 30: 25, 1954.
- Williams, R. J. *Alcoholism as a Nutritional Problem*, *J Clin Nutrition* 1: 72, 1952.
- Woolf, Ruth. *The Essential Fatty Acids*, *Borden's Rev Nutrition Res*, vol 9, April, 1948.
- Yudkin, Arthur M. *Nutrition as It Affects the Eye*, *M Clin North America* 27: 733, 1943.

### *Physiological Chemistry*

- Arnow, Earle I., and Benz, Henry C. *Introduction to Organic and Biological Chemistry*, ed 3, St. Louis, 1953, The C. V. Mosby Company.
- Bogert, L. E. *Fundamentals of Chemistry*, ed 7, Philadelphia, 1953, W. B. Saunders Company.
- Hawk, Philip B. Oser, Bernard L., and Summerson, William H. *Practical Physiological Chemistry*, ed 12, Philadelphia, 1947, The Macmillan Company.
- Kleiner, Israel G. *Human Biochemistry*, ed 3, St. Louis, 1951, The C. V. Mosby Company.
- Peterson, W. H., Skinner, I. T., and Strong, E. M. *Elements of Food Biochemistry*, New York, 1943, Prentice Hall Inc.
- Roe, Joseph H. *The Principles of Chemistry*, ed 7, St. Louis, 1950, The C. V. Mosby Company.
- Stanford University Press. *Annual Review of Biochemistry*, vol 1, 17, Stanford University, 1932 and annually thereafter.

### *Physiology and Medicine*

- Best, Charles Herbert and Taylor, Norman Burke. *The Physiological Basis of Medical Practice*, ed 5, Baltimore, 1950, The Williams & Wilkins Company.
- Carlson, Anton J. and Johnson, Victor. *The Machinery of the Body*, rev ed, Chicago, 1953, University of Chicago Press.
- Cecil, Russell L. *Textbook of Medicine*, ed 8, Philadelphia, 1951, W. B. Saunders Company.
- Stanford University Press. *Annual Review of Physiology*, vols 1 through 10, Stanford University, 1933 and annually thereafter.
- Wiggers, Carl J. *Physiology in Health and Disease*, ed 3, Philadelphia, 1940, Lea & Febiger.
- Zoethout, W. D., and Tuttle, W. W. *Textbook of Physiology*, ed 11, St. Louis, 1952, The C. V. Mosby Company.

### *Pregnancy and Lactation*

- Becker, J. Ernestine. *Nutrition in Pregnancy*, *Am J Nursing* 41: 1, 1941.
- Berry, K. *An Experiment in Diet Education During Pregnancy*, *Milbank Memorial Fund* 30: April, 1952.
- Bowlly, J. *Maternal Care and Mental Health*, *World Health Organization, Monograph Series No. 2*, 1952.
- Burke, B. S., and others. *Nutritional Studies During Pregnancy*, *Am J Obst & Gynec* 46: 38, 1943.

- Burke, B S, and Stuart, H C Nutritional Requirements During Pregnancy and Lactation *J A M A* 137 May, 1948
- Maternal Nutrition and Child Health, Bulletin No 123 of the National Research Council, November, 1950
- Scrimshaw, Nevin S Evaluation of Nutrition in Pregnancy, *J Am Dietet A* 26 21, 1950

### Protein

- Albanese, Anthony A The Effect of Amino Acid Deficiencies in Man, *J Clin Nutrition* 1 44, 1952
- Allison, James B Amino Acid Requirements of Man, *Borden's Rev Nutrition Res*, vol 14, Sept Oct, 1953
- Anderson, George K The Importance of Protein in Diet Therapy, *J Am Dietet A* 21 436, 1945
- Block, R J, and Bolling D The Amino Acid Composition of Proteins and Foods, ed 2, Springfield, Ill, 1951, Charles C Thomas
- Cannon, P Symposia on Nutrition, vol II, Plasma Proteins By the Robert Gould Research Foundation, Inc, Springfield, Ill, 1950, Charles C Thomas
- Elman, Robert Protein Metabolism and the Practice of Medicine, *M Clin North America* 27 303, 1943
- Griswold, Ruth M Effect of Heat on the Nutritive Value of Proteins, *J Am Dietet A* 27 85, 1951
- Gyorgy, Paul On Some Aspects of Protein Nutrition, *Am J Clin Nutrition* 2 231 1954
- Kirsner, Joseph B, and others Protein Nutrition in Gastrointestinal Disorders, *J Am Dietet A* 29 1103, 1953
- Lewis, Howard B Fifty Years of Study of the Role of Protein in Nutrition, *J Am Dietet A* 28 701, 1952
- Madden ■ C and others Ten Amino Acids Essential for Plasma Protein Production Effective Orally or Intravenously, *J Exper Med* 77 277, 1943
- The Problem of Heat Injury to Dietary Protein, Bulletin No 131, National Research Council, June, 1950
- Protein Metabolism Hormones and Growth A Symposium of Six Lectures, New Brunswick N J, 1953, Rutgers University Press
- Protein Nutrition in Health and Disease A Series of Nine Articles Prepared Under the Auspices of the Council on Foods and Nutrition of the American Medical Association, 1945 Issued in booklet form by Mead Johnson Company
- Rhoads J E Fliegelman M T, and Panzer, L M The Mechanism of Delayed Wound Healing in the Presence of Hypoproteinemia, *J A M A* 118 21, 1942
- Rose, W C, Harris, W J, and Johnson, J E The Role of the Amino Acids in Human Nutrition, *J Biol Chem* 146 683, 1942
- Rose, W C, Harris, W J, Johnson J E, and Warner D T Further Experiments on the Role of the Amino Acids in Human Nutrition, *J Biol Chem* 148 457, 1943
- Stare, F G Protein Nutrition in Problems of Medical Interest, *J A M A* 127 1052, 1945
- Stare, F G Protein Its Role in Human Nutrition, *J A M A* 127 985, 1945

### Teeth

- A Survey of the Literature of Dental Caries, Publication No 225, National Research Council 1952
- Blayney, W A How Does the Use of Carbonated Beverages Affect Dental Health? *J Am Dietet A* 23 515, 1947

- Lowle, Paul I. Manifestations of Vitamin A Deficiency in a Human Tooth Germ, *J Dent Res* 13 20, 1933
- Phenstern Benjamin. The Coll War on Dental Caries, *J Am Dietet A* 26 173, 1936
- Gottlieb Bernhard. A New Theory of Tooth Decay, *Scient American* 170 20, 1918
- Kriesner A L, Mann A W, and Sjies, T D. Relationship of Dental Caries to Deficiencies of the Vitamin B Group, *J Dent Res* 21 270, 1942
- McClure F I. Fluorine in Food and Drinking Water, *J Am Dietet A* 29 500, 1953
- LaFusch Dorthes I. Diet and Dental Health, *J Am Dietet A* 29 555, 1953
- Shaw, James H. Dietary Approaches to the Study of Dental Caries, *J Am Dietet A* 21 181 1948
- Woods Ruth. Role of Fluorine in the Diet, *Borden's Rev Nutrition Res*, vol 9, March 1948

### *Texts on Nutrition for Nurses*

- Cooper, Lena I. Barber Edith M. Mitchell Helen S, and Rynbergen, Henlerika. Nutrition in Health and Disease ed 12, Philadelphia, 1953 I B Lippincott Company
- Dent Alberta. Food and Nutrition Workbook Ann Arbor, Mich, 1948, Edwards Br there
- Johnson, Doris. Modern Dietetics New York, 1951, G P Putman's Sons
- MacLeod, Grace and Taylor Clara. Revision of Rose's Foundations of Nutrition ed 4 New York 1944 The Macmillan Company
- Mitchell Katherine and North Genevieve I. Food in Health and Disease ed 5 Philadelphia 1953 I A Davis Company
- Pattee Alda Frances. Practical Dietetics ed 3 revised by Hazel F. Munsell Mount Vernon N Y A I Pattee
- Proudfit Fairfax I and Robinson Gertrude H. Nutrition and Diet Therapy ed 10 New York The Macmillan Company

### *Vitamins*

- American Medical Association. The Vitamins A Symposium Chicago 1939
- Axelrod A I. Vitamins and Antibodies. *Nutrition Rev* 10 353, 1952
- Bean, William B and Vace Margaret. Some Aspects of the Tongue in Pellagrous Glossitis *J Clin Nutrition* 1 217 1953
- Best, Charles H. Early Experiences With Choline—A Retrospect, *Nutrition Rev* 11 321 1953
- Iddy, W H. Vitaminology the Chemistry and Functions of Vitamins, Baltimore Williams & Wilkins Company
- Flvehjem C A. Early Experiences With Nicotin—A Retrospect, *Nutrition Rev* 11 289 1953
- Grant, Faye W and Smith Raymond F. Psycho Motor Performance and Vitamin Intake *J Am Dietet A* 28 1046 1952
- Gyorgy Paul. Early Experiences With Riboflavin—A Retrospect, *Nutrition Rev* 12 97 1954
- Investigations of Human Requirements for B Complex Vitamins, Bulletin No 116 National Research Council June 1948
- King Charles Glen. Early Experiences With Ascorbic Acid—A Retrospect, *Nutrition Rev* 12 1 1954
- Krehl, Willard A. Pantothenic Acid in Nutrition, *Nutrition Rev* 11 225, 1953
- Krehl Willard A. Vitamin A I The Visual Process, *Borden's Rev Nutrition Res*, vol 13, May, 1952

- Krehl, Willard A. Vitamin A II Interrelationships Between Pro Vitamins A and Vitamin A, *Borden's Rev Nutrition Res*, vol 13, June, 1952
- Krehl, Willard A, and Winters, R W Effect of Cooking Methods on Retention of Vitamins and Minerals in Vegetables, *J Am Dietet A* 26 966, 1950
- Lepkovsky, Samuel Early Experiences With Pyridoxine—A Retrospect, *Nutrition Rev* 12 257, 1954
- Moore, T The Interrelationship of Vitamins, *Vitamins & Hormones* 3 1, 1945
- Peterman, Robert A, and Goodhart, Robert S Current Status of Vitamin Therapy in Nervous and Mental Disease, *J Clin Nutrition* 2 11, 1954
- Peterson, W H The Folic Acid Story—Reminiscences, 12 225, 1954
- Spies, T D, and others Pellagra, Beriberi, and Riboflavin Deficiency in Human Beings, *J A M A* 113 931, 1939
- Spies, T D, Vitler, R W, and Ashe, W F Pellagra, Beriberi, and Riboflavin Deficiency in Human Beings *J A M A* 113 931, 1939
- Stearns, Genevieve Early Experiences With Vitamin D in the Nutrition of Infants and Children—A Retrospect, *Nutrition Rev* 12 193, 1954
- Warkany, Josef Vitamin D Deficiency (Rickets), *M Clin North America* 27 361, 1943
- Williams, Robert R Recollections of the Beriberi Preventing Substance, *Nutrition Rev* 11 257, 1953
- Williams, Robert R The World Beriberi Problem Today, *J Clin Nutrition* 1 513, 1953
- Williams, Roger J What to Do About Vitamins, Norman, Oklahoma, 1945 University of Oklahoma Press
- Williams, Roger J Early Experiences With Pantothenic Acid—A Retrospect *Nutrition Rev* 12 65, 1954
- Williams, Roger J Alcoholism as a Nutritional Problem, *J Clin Nutrition* 1 32, 1952
- Woods, Ruth The Biosynthesis of Vitamins, *Borden's Rev Nutrition Res*, vol 7, May, 1946
- Wright, Lemuel D The Significance of Anti Vitamins in Nutrition, *J Am Dietet A* 23 289, April, 1947

### *Weight Control*

- Armstrong, Donald B, and others Obesity and Its Relation to Health and Disease, *J A M A* 147 1007, 1951
- Barborka Clifford J Present Status of the Obesity Problem, *J A M A* 147 1015, 1951
- Bayles Spencer, and Ebaugh, Franklin G Emotional Factors in Eating and Obesity, *J Am Dietet A* 26 430, 1950
- Beaudoin Rachel, Van Itallie, T B, and Mayer, J Carbohydrate Metabolism in "Active" and "Static" Human Obesity, *J Clin Nutrition* 1 91, 1953
- Bruch, Hilde Psychological Aspects of Obesity, *Bull New York Acad Med* 24 73, 1948
- Chapman, A L Weight Control—A Simplified Concept, *Pub Health Rep* 66 725 1951
- Gill, Dorothy J The Role of Personality and Environmental Factors in Obesity, *J Am Dietet A* 22 399 1946
- Jolliffe, Norman Reduce and Stay Reduced, New York, 1952, Simon and Schuster
- Jolliffe, Norman, and Alpert, Elmer The Performance Index as a Method of Estimating the Effectiveness of Reducing Regimens, *Postgraduate Med* 9 106, 1951

- Mayer, J. The Glucostatic Theory of Regulation of Food Intake and the Problem of Obesity, *Bull New England Med Center* 14: 43, 1952.
- Mitchell, H. H. Overnutrition and Obesity, *J Clin Nutrition* 1: 66, 1952.
- Newburgh, L. H. Energy Metabolism in Obese Patients, *Bull New York Acad Med* 24: 227, 1948.
- Newburgh, L. H. Obesity, A Monograph, reprinted from *Arch Int Med* 70: 1031, 1942.
- Pennington, A. W. An Alternate Approach to the Problem of Obesity, *J Clin Nutrition* 1: 100, 1953.
- Pennington, A. W. Treatment of Obesity With Calorically Unrestricted Diet, *J Clin Nutrition* 1: 343, 1953.
- Pearson, Edward H., and Gastineau, Clifford F. Obesity, Springfield, Ill., 1949, Charles C Thomas.
- Simmons, William D., Kuzek, Robert F., and Walsh, Helen F. Group Approach to Weight Reduction, A Group of Three Articles, *J Am Dietet A* 30: 457, 1954.
- Trulsson, M., Walsh, J. D., and Case, F. K. A Study of Obese Patients in a Nutrition Clinic, *J Am Dietet A* 26: 755, 1950.
- Young, Charlotte M. Weight Reduction Using a Moderate Fat Diet. I. Clinical Response and Energy Metabolism, *J Am Dietet A* 28: 410, 1952.



# PART VI

## APPENDIX

TABLE 120—*Approximate Food Values for Gross Planning of Diets*

Since the 100 calorie portions in general the average serving or a simple fraction or multiple thereof it is possible to list roughly foods of equal caloric content in typical food groups. Within these groups the foods suggested are interchangeable and one selects the food preferred. Such a list follows:

<b>Cereals (100 cal)</b>		Ginger snaps vanilla wafers chocolate wafers 5	
20 gm C 4 gm P 1 gm F		Macaroons 2 or 3	
Corn flakes 1 $\frac{1}{4}$ cups		Fruits (see above)	
Cream of Wheat $\frac{2}{3}$ cup		Sugar cookies 1	(100 cal)
Grape Nuts 2 tbs		Pie, small piece	
Muffets or shredded wheat 1		Puddings average serving	
Oatmeal cooked $\frac{3}{4}$ cup		Fried cakes 1	
Puffed wheat or rice 1 cup		Cake average piece	
		Ice cream average serving	
<b>Fruits (100 cal)</b>		<b>Vegetables (25 cal)</b>	
20 gm C 2 gm P		5 or less gm C 1 gm P	
Apples 1 large		Asparagus 6 stalks	
Apricots dried 8 halves		Cabbage cooked $\frac{3}{4}$ cup	
Banana 1 small		Cauliflower large serving	
Canned cherries $\frac{3}{4}$ cup		Greens $\frac{1}{2}$ cup	
Grapefruit $\frac{1}{2}$ 1 cup juice		Mushrooms 6	
Grapes 1 med bunch		Sauerkraut $\frac{1}{2}$ cup	
Orange 1 large 1 cup juice		Spinach $\frac{1}{2}$ cup	
Pear 3 halves		Tomato fresh 1 med	
Peaches 3 halves		Tomato canned $\frac{1}{4}$ cup	
Pineapple 1 slice		Tomato juice $\frac{1}{2}$ cup	
Prunes 3 to 4		Turnips $\frac{1}{2}$ cup	
Watermelon large serving			
<b>Breads and Crackers (100 cal)</b>		<b>Vegetables (50 cal)</b>	
Breads 20 gm C 3 gm P 1 gm F		10 gm C 1 gm P	
Crackers 16 gm C 3 gm P 3 gm F		Beets dried $\frac{1}{2}$ cup	
White or brown 1 thick slice		Carrots $\frac{1}{4}$ cup	
Parker house roll 1		Onions 2 med	
Saltines 6		Turnips $\frac{1}{2}$ cup	
Oyster crackers 16			
Meiwa toast 2 slices		<b>Vegetables (75 cal)</b>	
Zwback 3 slices		15 gm C 1 gm P	
		Lima beans, fresh $\frac{1}{2}$ cup	
<b>Potato or Potato Substitute (100 cal)</b>		Corn on cob 2 small ears	
20 gm C 3 gm P		Parsnips $\frac{1}{2}$ cup	
White potato 1 med		Peas young $\frac{1}{2}$ cup	
Potato chips $\frac{2}{3}$ cup			
Sweet potato $\frac{1}{2}$ med		<b>Meats med fat (150 cal)</b>	
Macaroni cooked 1 cup		16 gm P 10 gm F	
Noodles cooked $\frac{3}{4}$ cup		Porterhouse steak 1 med chop	average serving
		Pork loin 1 med chop	
<b>Vegetables (100 cal)</b>		Veal cutlet large serving	
20 gm C 2 gm P		Ham small serving	
Baked beans $\frac{1}{2}$ cup		Leg of lamb small serving	
Lima beans $\frac{1}{2}$ cup		Broiler large serving	
Beanitos beans $\frac{1}{2}$ cup		Fowl small serving	
Peas $\frac{3}{4}$ cup			
Corn $\frac{1}{2}$ cup		<b>Meat Substitutes (100 cal)</b>	
		American cheese 6 gm P 8 gm F	
<b>Desserts—Variable</b>		Cottage cheese 18 gm P 1 gm F 4 gm C	
Puddings (Spanish cream)		Egg 9 gm P 7 gm F	
12 gm P 7 gm F 21 gm C		Liver average serving	
Cakes (butter)		Sausage frankfurter 1	
Pie (apple)		Cottage cheese 5 to 6 tbs	
3 gm P 7 gm F 30 gm C			
(100 cal)			

TABLE 120—CONT'D

Cheese  $1\frac{1}{4}$  in cube  
Oysters  $\frac{3}{4}$  cup  
Scallops  $\frac{3}{4}$  cup  
Bacon 2 to 3 slices  
Sausage pork 1 small  
Fish, average serving for eight salmon, mackerel, whitefish, etc. (small serving of these)  
Egg 1 to  $1\frac{1}{2}$

*Beverages (100 cal)*

Whole milk 5 gm P, 6 gm F, 7.4 gm C  
Skim milk 9 gm P, 1 gm F, 14 gm C  
Fruit juice 23 gm C, 1 gm P  
Milk  $\frac{3}{4}$  cup  
Skim milk  $1\frac{1}{4}$  cups  
Buttermilk  $1\frac{1}{4}$  cups  
Carbonated drinks  $1\frac{1}{2}$  cups  
Fruit juice 1 cup

*Miscellaneous*

(100 cal)

Butter 1 tbs  
Sugar 5 tsp  
Cream (coffee) 4 tbs  
Mayonnaise 1 tbs  
Jelly  $1\frac{1}{2}$  tbs  
Cream (whipped) 2 tbs

*Candies (100 cal)*

Variable—largely sugars  
Caramels 1  
Nougats  $1\frac{1}{2}$   
Chocolate peppermints  $1\frac{1}{2}$   
Gum drops 3  
Marshmallows 4  
Fudge 1 in cube  
Milk chocolate  $\frac{1}{4}$  of 5 cent bar





TABLE 121—FOOD EQUIVALENTS FOR INTERCHANGES IN THE DIET

Foods, when nearly equal in food value, may be substituted for one another in the diet. Fruits, vegetables, and cereals are interchanged on the basis of their carbohydrate content, butter, cream, and oils according to their fat content, and meats, cheese, and eggs according to the amounts of protein and fat which they contain.

Five per cent vegetables are those which contain approximately 5 gm. carbohydrate per 100 gm. vegetable (1 level teaspoonful of sugar weighs 4 gm.) In general, a serving of vegetable will weigh approximately 100 gm. and can be measured roughly as a half cup.

A 10% vegetable or fresh fruit, or fruit canned without sugar, contains 10 gm. carbohydrate per 100 gm. Obviously, there is as much carbohydrate in a half cup of a 10% vegetable as in 1 cup of a 5% vegetable.

An attempt to classify foods into a few groups sufficiently inclusive to be practical, of course, has disadvantages. More sharply defined grouping according to carbohydrate content, by increasing the number of groups, makes for cumbersome detail. For example, the 5% group is sometimes further divided into 1, 3 and 5% vegetables, the 10%, into 6, 9 and 12% vegetables, etc. If one takes into account the differences in composition, age, freshness, cooking losses, etc., perhaps this wide grouping should still be used until new data accumulate. When more complete analyses are available reclassification can be undertaken.

A classification of vegetables follows.

5% and under (may be averaged as 3%)

Artichokes, French

Asparagus

Beet greens

Broccoli

Brussels sprouts

Cabbage

Cauliflower

Celery

Cucumber

Eggplant

Endive

Kohlrabi

Leeks

Lettuce

Mushrooms

Peppers, green or red

Radish

Sauerkraut

Swiss chard

Spinach

Squash, summer

String beans, very young or

canned\*

Tomatoes and tomato juice

Water cress

Artichokes, Jerusalem

Beans, Lima, very young or  
canned\*

Corn, on cob and young

Parsnips

Peas, fresh

Salady or vegetable oyster

20%

Beans, baked

kidney

Lima

navy

shelled butter

Corn, canned

Lentils

Succotash, canned

Potato, white

Rice } may be considered  
Macaroni } to have same value  
Hominy } as 20% vegetable

10%

Beets

Carrots

Celery roots

Onions

Pears, very young or canned\*

Pumpkin

Rutabagas

Squash, winter or Hubbard

String beans, fresh

Turnip

The vegetables containing 10% or less carbohydrate have a protein content of approximately 1%, the 20% group contains, on the average, 3% protein.

Fruit values are based on products canned without additional sugar.

\*Liquid discarded—heated in fresh water.

## TARIF 121—CONT'D

The value for fruits is essentially the same whether the fruit is raw or canned provided the canning is done without sugar. The canning may be as a water pack, or the fruit may be canned in its own juice (juice pack). However, water packed fruits, if the water is discarded, have a somewhat reduced carbohydrate content (approximately 4%), compared with fresh fruit, due to carbohydrate that goes into solution.

The 5% fruits are avocado, honeydew melon, watermelon, muskmelon, rhubarb, and strawberries.

The 10% fruits are

*Canned*

Apple-juice  
 Apricots  
 Blackberries  
 Blueberries  
 Cherries  
 Figs  
 Fruit salad  
 Grapes, seedless  
 Grapefruit, also juice  
 Loganberries  
 Peaches  
 Pears  
 Pineapple slices  
 Plums  
 Raspberries, red or black

*Fresh*

Blackberries  
 Cranberries  
 Currants  
 Grapefruit  
 Lemons  
 Loganberries  
 Oranges  
 Peaches  
 Tangerines

Fruits considered as approximately 15% are as follows

Apples  
 Apricots, fresh  
 Blueberries, fresh  
 Cherries, sour  
 Grapes

Huckleberries  
 Pears  
 Pineapple juice  
 Raspberries, fresh

Fruits considered as approximately 20% are

Bananas  
 Cherries, sweet  
 Figs, fresh

Grape juice  
 Prunes and plums, fresh

All dried fruits are over 60% carbohydrate

TABLE 122

APPROXIMATE PROTEIN VALUES (See Table 138 for Details)

		OM
Bacon	3 slices	2
Breads	1 slice "sliced"	3
Cereal	Average 1 oz servings	
	Oatmeal	4½
	Puffed, flaked, etc	2
	Whole wheat	3
Cheese	Average serving 1½ × 1 × 1 in cube	
	American or Cream	5
	Cottage 2 tbs	5
	Swiss 1 slice	11
Eggs	White	3
	Whole	6
	Yolk	3
Fish—Fowl—Meat	1 oz serving	5
	Average serving 3 4 oz	
Fruits	Average size of 1½ c cut up	1
Gelatin	Average serving—½ c	2
Legumes	Average serving—½ c	6 8
Meat	See Fish	
Milk	Fluid buttermilk Skim or whole	
	1 qt	32
	1 c	8
	Dried Malted 1 tbsp	1
	Skim 1 tbsp	3
	Whole 1 tbsp	2
	Evaporated 1 tbsp	1
Oysters	Average serving 5 or 6	6
Peanuts	30 nuts or 2 tbsp butter	8
Potato	White 1 average (5 oz)	3
Vegetables other than legumes or potato	Average serving—½ c	1
A few special foods or puddings—1 tbsp each		
	Betene	3
	Casee	2
	Casein (crude edible)	9
	Cocosalt	1½
	Dietene	2½
	Nutramigin	1½
	Olac	2
	Protein Milk	3
	Soy Flour	0
	Vege	3½
	Yeast—Dried	6

TABLE 123

## APPROXIMATE CALORIE CONTENT OF COMMON FOODS\*

<i>Food</i>	<i>Amount</i>	<i>Approximate Calories</i>
Apple, baked, with sugar	1 large	150
Apple, fresh	1 large	100
Applesauce, sweetened	1 average serving	140
Apricots, canned	1 average serving	100
Apricots, dried, stewed, sweetened	1 average serving	75
Apricots, fresh	1 large	25
Asparagus, canned	1 average serving	15
Asparagus, fresh	1 average serving	15
Avocado pear	1 $\frac{1}{2}$	165
Bacon	1 average serving	85
Banana	1	100
Beans, green, string	1 average serving	30
Beans, Lima, dried, stewed	1 average serving	175
Beans, Lima, fresh	1 average serving	125
Beans, navy, cooked	1 average serving	150
Beef, corned	1 average serving	125
Beef, dried, creamed	1 average serving	250
Beef, Hamburg	1 cake	125
Beef, meat loaf	1 average serving	150 200
Beef, pot roast (lean)	1 average serving	200
Beef, round (lean)	1 average serving	150 200
Beef, sirloin, roast (lean)	1 average serving	150
Beef vegetable stew	1 average serving	230
Beet greens	1 average serving	30
Beets	1 average serving	40
Biscuit, baking powder	1 medium	75
Blackberries, fresh	1 average serving	75
Blueberries, fresh	1 average serving	75
Bluefish	1 average serving	125
Bologna sausage	1 average serving	120
Bread, corn	1 slice	150 200
Bread, enriched, 100% whole wheat, rye, etc.	1 slice	65 75
Bread, raisin	1 slice	85 100
Broccoli	1 average serving	30
Brussels sprouts	1 average serving	50
Butter	1 average pat	100
Buttermilk	1 glass	90
Cabbage, cooked	1 average serving	50
Cabbage, raw, shredded	1 average serving	20
Cake, angel food	1 average serving	125 150
Cake, frosted	1 average serving	150 175
Cake, layer, frosted and filled	1 average serving	400 450
Cake, plain	1 average serving	100 125
Cake, sponge	1 average serving	125 150
Candy	1 piece	50 100
Cantaloupe	$\frac{1}{2}$	60
Carrots, cooked	1 average serving	50
Cauliflower	1 average serving	20

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<i>Food</i>	<i>Amount</i>	<i>Approximate Calories</i>
Celery	2 stalks	10
Cereal, cooked	1 average serving	100
Cereal, ready to serve	1 average serving	50 100
Chard, Swiss	1 average serving	45
Cheese, American, Gruyère, Swiss	1 average serving	100 125
Cheese, cottage	1 generous serving	85
Cheese, cream	1 small serving	80
Cherries, canned	1 average serving	100 150
Cherries, fresh	1 average serving	75
Chicken, roast	1 average serving	200
Clams, round	1 average serving	80 100
Cod steak	1 average serving	125
Collards	1 average serving	65
Cookies, plain	1	50
Corn, canned	1 average serving	150
Corn, fresh	1 average serving	150
Crab meat, canned	1 average serving	70
Crackers, butter or saltines	1	15
Cranberry sauce, canned	1 average serving	75
Cream, heavy	2 tablespoons	125
Cream, coffee	2 tablespoons	50
Cucumber	1 average serving	10
Custard, baked or "boiled"	1 average serving	125
Dandelion greens	1 average serving	40
Dates, pitted	1	20 25
Eggs	1	70-75
Escarole	1 average serving	25
Fish cakes	2	200 250
Frankfurter	1 medium	100
Gelatin, fruited	1 average serving	100 125
Gingerbread	1 average serving	200
Grapefruit	$\frac{1}{2}$ medium	100
Grapefruit juice	$\frac{1}{4}$ cup	75
Grapefruit sections	1 average serving	65
Grapejuice	$\frac{3}{4}$ cup	130
Grapes, Concord	1 medium bunch	80
Gravy, brown	1 tablespoon	20 25
Halibut	1 average serving	175
Ham cooked	1 average serving	250 300
Hash, beef	1 average serving	350
Honey	1 average serving	50
Honeydew melon	2 tablespoons	200
Ice cream, commercial	1 average serving	200 250
Ice, fruit	1 average serving	150 175
Jams, jellies	1 average serving	100
Kale	1 average serving	40
Kidney	1 average serving	150
Lamb (lean)	1 average serving	150 200
Lamb stew	1 average serving	400
Lentils	1 average serving	150
Lettuce	1 average serving	20
Liver	1 average serving	200
Liverwurst sausage	1 average serving	100 150
Lobster meat	1 average serving	100
Loganberries	1 average serving	75
Macaroni	1 average serving	135

<i>Food</i>	<i>Amount</i>	<i>Approximate Calories</i>
Mackerel	1 average serving	125 150
Margarine	1 average pat	100
Milk, condensed, sweetened	1 tablespoon	65
Milk, evaporated	$\frac{1}{4}$ cup	90
Milk, skimmed	1 glass	90
Milk, whole	1 glass	170
Muffins	1 medium	100 150
Mustard greens	1 average serving	30
Noodles	1 average serving	135
Oatmeal	1 average serving	90 100
Okra	1 average serving	30
Onions	1 medium	30 35
Orange juice	1 cup	130 140
Oranges, whole	1	80 100
Oysters	1 average serving	100 120
Parsnips	1 average serving	65
Peaches, canned	1 average serving	90 100
Peaches, fresh	1	50 60
Peanut butter	2 tablespoons	200 225
Pears, canned	1 average serving	50
Pears, fresh	1	50 60
Pears, canned, drained	1 average serving	65
Pears, fresh	1 average serving	85
Peppers, green	1 large	25
Persimmon	1	100
Pie, apple	1 average wedge	250
Pie, blueberry	1 average wedge	275
Pie, cherry	1 average wedge	375
Pie, custard	1 average wedge	250
Pie, lemon meringue	1 average wedge	350
Pie, mince	1 average wedge	350
Pie, pumpkin	1 average wedge	300
Pie, rhubarb	1 average wedge	275
Pineapple, canned	1 average serving	75
Pineapple, fresh	1 average serving	65
Pineapple juice, canned	1 glass	150
Plums, fresh	1	25 30
Pork, cooked	1 average serving	150 200
Potatoes, French fried	1 average serving	125
Potatoes, mashed	1 average serving	125
Potatoes, sweet	1	200 225
Potatoes, sweet, candied	1 average serving	300
Potatoes, white, baked, or boiled	1	100
Prunes, dried stewed, sweetened	1 average serving	125
Pudding, bread	1 average serving	250 300
Pudding, cornstarch	1 average serving	200
Pudding, rice	1 average serving	125 150
Radishes	1 average serving	10 12
Raisins	1 tablespoon	40 45
Raspberries, fresh	1 average serving	65
Rhubarb, stewed, sweetened	1 average serving	125
Rice, brown or white	1 average serving	100 125
Rolls, Parker House	1	100
Rutabagas	1 average serving	75

<i>Food</i>	<i>Amount</i>	<i>Approximate Calories</i>
Salad dressing	1 average serving	
Boiled	1 average serving	50
French	1 average serving	150
Mayonnaise	1 average serving	150
Russian	1 average serving	125
Salmon, canned or fresh	1 average serving	100 150
Sandwich	1	250 300
Sardines, canned	1 average serving	75 100
Sausage, pork	1	60
Scallops, fried	1 average serving	250
Shad roe	1 average serving	200
Sherbet, fruit	1 average serving	175 200
Soda, bottled	1 average serving	65 75
Soda ice-cream	1 average serving	300 350
Soup bouillon or consommé	1 average serving	20
Soup, cream of vegetable	1 average serving	175 200
Soup, tomato, clear	1 average serving	75
Soup, vegetable	1 average serving	80 100
Soybeans, yellow, dried	1 tablespoon	50
Squash	1 average serving	30
Squash, Hubbard	1 average serving	60
Squash, summer	1 average serving	30
Strawberries, fresh	1 average serving	60
Succotash	1 average serving	175
Sugar, brown	1 tablespoon	35
Sugar, granulated	1 teaspoon	17
Sundae	1	350-500
Tangarine	1	40 50
Tapoca cream	1 average serving	125
Tomato juice	$\frac{1}{2}$ cup	30
Tomatoes, canned	1 average serving	40
Tomatoes, fresh	1	30 40
Tongue	1 average serving	125
Tuna fish	1 average serving	150
Turkey	1 average serving	300
Turnip greens	1 average serving	45
Turnips, white	1 average serving	35
Veal, cooked	1 average serving	200
Water cress	1 average serving	5
Watermelon	1 average serving	100 125

Inasmuch as the calculation of the sodium value of the diet is practiced so frequently at the present time, the following detailed table is offered

# SODIUM AND POTASSIUM ANALYSES OF FOODS AND WATERS FROM THE RESEARCH LABORATORY OF MEAD JOHNSON & COMPANY, 1947

## Foreword

Previously available tables giving the sodium content of foods and public water supplies have always been compiled from data obtained by the conventional methods of chemical analysis. It is well known that in most of these methods traces of potassium tend to be weighed as sodium so that when the amount of sodium is small an appreciable error is introduced, which may be relatively large as the quantity of sodium approaches zero. The following data were obtained by flame photometry and are believed to represent a new order of accuracy in figures for sodium.

In spite of the character of the individual analyses it must be kept in mind that the figures represent only single samples or at most a few samples of the material examined. For this reason the findings are reported in no more than two significant figures and only in one significant figure when the content is less than 10 mg. per 100 grams. The individual samples were analyzed in duplicate. Emphasis was given to unprocessed or slightly processed foods rather than to culinary creations in which the use of salt and other sodium compounds is highly variable. Brand names of manufactured products are given only when their use is unavoidable but in general leading brands are represented.

It will be noted that natural foods usually contain less sodium than those which have been processed. For example fresh peas are almost sodium free but canned frozen and dry split peas contain large amounts of added sodium. Sodium compounds are so widely used in processing foods, and their use in most circumstances is so harmless that the pure food laws do not require label declarations in many instances. Foods labeled as containing salt should of course be avoided in low sodium diets, but the absence of such label statements is no guarantee that large amounts of sodium are not present.

As a rule fresh foods of vegetable origin contain little sodium, while foods of animal origin contain much sodium even when none is added. Thus the protein sources having the highest biological value are also the high sodium foods—meat, eggs and milk. The low sodium product Lonalac was specially designed to provide a protein food of animal origin suitable for liberal use in low sodium diets.

Values for potassium are included for the benefit of research workers interested in the role of this element. Information on many foods not listed is available on request. Physicians should bear in mind that the listing of any given food as of low sodium content does not imply that such food is in every other respect a suitable one for all patients. Attention is called to the listing of public water supplies at the end of these tables, because drinking water in some communities is a significant source of dietary sodium.

TABLE 124

FOOD*	Na, MG PER 100 GM	K, MG PER 100 GM	FOOD	Na, MG PER 100 GM	K, MG PER 100 GM
Allspice, ground	62	680	Bread, whole wheat	930	210
Almond	2	690	Broccoli	16	400
Almond, roasted in oil and salted	160	710	Brussels sprouts	11	450
Anchovy paste	12,000	1,900	Brussels sprouts, frozen	■	300
Apple juice (sweet cider), bottled	4	100	Butter, average salted Theoretical value based on U S average salt content of 2.5%	980	-----
Apple, less skin	0.1	68	Butter, lightly salted	780	16
Applesauce, canned	0.3	55	Butter, unsalted	5	4
Apricot	0.5	440	Buttermilk, cultured	130	140
Apricot, canned in syrup	2	65	Cabbage	■	230
Asparagus, spears, canned	400	130	Cantaloupe	12	230
Asparagus, tips	■	240	Caraway seed	16	1,400
Asparagus, tips, frozen	3	320	Carrot	31	410
Avocado	■	340	Carrot, canned	280	110
Bacon	760	95	Cashew nut	13	560
Bacon, fried crisp	3,200	450	Cashew nut, roasted in oil and salted	200	560
Banana	0.1	400	Catchup, tomato	1,300	800
Barley, pearled	3	160	Catfish (fiddler)	60	330
Bean, Great Northern, dry	0.3	1,400	Cauliflower, bud	24	400
Bean, green	0.8	300	Cauliflower, bud, frozen	22	290
Bean, green, canned	410	120	Caviar, salmon	2,200	640
Bean, green, frozen	2	110	Celery salt	26,000	3,100
Bean, Lima	1	680	Celery, seed	140	1,400
Bean, Lima, canned	310	210	Celery, stalks	110	300
Bean, navy, dry	0.9	1,300	Cereal, bran	1,400	1,200
Beef, corned	1,700	400	Cereal, wheat, Instant Ralston	1	360
Beef, dried	3,900	1,000	Cereal, wheat, Maltex	4	250
Beef, less excess fat	53	380	Cereal, wheat, Pettijohn's	■	380
Beer	8	46	Cereal, wheat, Wheatena	1	380
Beet	110	350	Cheese, American Swiss	420	110
Beet, canned	36	120	Cheese, cheddar	540	130
Beet leaves	130	570	Cheese, cottage	320	80
Blackberry	0.2	150	Cheese, cream	340	90
Blueberry	0.5	89	Cheese, process	1,500	440
Bouillon cube	27,000	1,500	Cheese, whey (cheese food)	1,500	520
Brain, pig	150	340	Cherry, dark sweet	1	260
Brandy	3	4	Cherry, dark sweet, canned in syrup	0.7	77
Brazil nut	0.8	650	Cherry, dark sweet, frozen in syrup	1	280
Brazil nut, roasted in oil and salted	190	730	Cherry, light sweet, canned in syrup	3	■5
Bread, low sodium, (made with Lonalac)	2	120	Chestnut	■	410
Bread, low sodium, cinnamon roll	■	120	Chicken, breast meat	78	320
Bread, Passover See matzoth	---	---			
Bread, rye and wheat	560	100			
Bread, semi whole wheat	670	300			
Bread, wheat, white	670	130			

\*Edible portions only Fresh uncooked material unless otherwise described.

TABLE 124—CONT'D

FOOD	Na, MC	K, MC	FOOD	Na, MC	K, MC
	PER 100 GM	PER 100 GM		PER 100 GM	PER 100 GM
Chicken, leg meat	110	250	Currant, Zante, dried		
Chocolate, milk	86	420	(Zante raisins)	22	730
Chocolate syrup	60	130	Curry powder	45	1,300
Chocolate,			Dandelion	76	430
unsweetened	4	830	Date, semi dry	0 9	790
Cider, sweet			Dextrin	14	14
(apple juice)	4	100	Dextrose	1	0 4
Cinnamon, ground	8	200	Flax, seed	12	1,000
Citron, canned	200	70	Duck, domesticated,		
Clam	180	240	breast meat	6 9	360
Coca Cola (soft drink)	1	52	Duck, domesticated,		
Cocoa, powder, Dutch			leg meat	96	210
process	55	3,200	Egg	140	130
Cocoa, powder,			Egg, whites only	200	110
ordinary, Hershey	4	1,400	Egg, yolks only	34	85
Coconut, dry, shredded	16	770	Eggplant	0 8	190
Cod	10	360	Endive	18	400
Cod, frozen fillets	100	400	Farina	0 8	88
Cod liver oil	0 1	0	Farina, quick cooking		
Cod, salted	7,200	60	enriched	100	95
Coffee, roasted	2	1,600	Fig	2	190
Corn flakes	660	160	Fig, canned in sirup	1	110
Corn meal, yellow,			Fig, dried	33	780
enriched	0 6	120	Filbert	0 8	560
Corn oil	0 2	0 1	Flour, bleached, en		
Corn, popcorn, popped			riched, Gold Medal	1	86
and oiled	3	320	Flour, bleached, en		
Corn, popcorn, popped,			riched phosphated	13	78
oiled and salted	1,500	340	Flour, buckwheat	1	680
Corn starch	4	4	Flour, gluten	2	24
Corn, sweet white,			Flour, rye, dark	1	860
canned	200	200	Flour, white, natural	1	120
Corn sweet white,			Fruit cocktail, canned		
milk stage	0 2	240	in sirup	9	160
Corn, sweet yellow,			Garlic	0	510
canned	210	200	Gelatin dessert, dry	330	210
Corn, sweet yellow,			Gelatin, plain, dry	27	11
frozen	9	190	Gin	0 7	0 3
Corn sweet yellow,			Ginger ale	8	0 6
milk stage	0 3	370	Ginger, ground	29	1,100
Corn, yellow, ■ varie			Gizzard, turkey	58	170
ties, dry	0 4	290	Gluten, wheat	2	21
Cowpea	1	560	Gooseberry	0 6	87
Crab, canned	1,000	72	Grape juice, Concord,		
Cracker, Graham	700	440	sweetened, bottled	1	120
Cracker, soda	1,500	500	Grape, Thompson		
Cranberry	1	63	seedless	4	180
Cranberry sauce,			Grapefruit	0 4	200
canned	1	17	Grapefruit juice,		
Cream whipping			sweetened, canned	0 4	150
(32% fat)	40	56	Gravy flavoring	86	280
Cucumber, less parings	0 8	230	Halibut	56	540
Currant	2	160	Ham, less excess fat	2,100	610

TABLE 124—CONT'D

FOOD	Na, MG	K, MG	FOOD	Na, MG	K, MG
	PER 100 GM	PER 100 GM		PER 100 GM	PER 100 GM
Hash, corned beef, canned	880	380	Milk, whole, liquid	51	140
Heart, beef	90	160	Molasses, cane	80	1,500
Heart, turkey	69	240	Mulberry	0 6	200
Hominy, canned	180	50	Mushroom	5	520
Honey	7	10	Mushroom, canned	470	260
Horseradish, prepared	96	290	Mustard greens	48	450
Ice cream, vanilla	100	90	Mustard, powder	3	840
Jam, grape	7	78	Mustard, prepared paste	1,100	280
Kale	110	410	Nutmeg, ground	14	180
Kidney, beef	210	310	Oats, rolled	2	340
Lamb, less excess fat	110	340	Okra, pods	1	220
Lard	0 3	0 2	Oleomargarine	1,200	230
Lemon, less rind	0 6	130	Olive, green pickled	2,200	290
Lettuce, head	12	140	Olive oil	0 2	0 2
Litchi, dried	3	1,100	Olive, ripe pickled	920	240
Liver, calf	110	380	Onion, white	1	130
Liver, pig	77	350	Orange	0 2	170
Liver, turkey	51	160	Orange Crush (soft drink)	2	100
Lobster, boiled in tap water	210	180	Orange juice, unsweetened, canned	0 4	190
Lonalac	20	1,200	Oyster, fresh	73	110
Lonalac, reliquified	2	160	Pancetta, pig	57	240
Macaroni	1	160	Paprika, powder	82	2,300
Mace, ground	45	180	Parsley	28	880
Maize See corn	-----	-----	Parsnips	7	740
Maple sirup	14	130	Peas	0 9	380
Marmalade, orange	13	19	Pea, canned, less liquor	230	180
Matzoth, American style	360	130	Pea, dry split	42	880
Matzoth, egg	16	160	Pea, frozen	100	160
Matzoth farfel	28	130	Peach	0 1	180
Matzoth meal	4	125	Peach, canned in sirup	6	31
Matzoth, Passover	1	140	Peach, frozen in sirup	3	120
Matzoth, plain	1	140	Peanut butter	120	820
Matzoth, poppy seed	350	140	Peanut oil	0 2	0 1
Matzoth, tasty wafer	430	260	Peanut, roasted in oil and salted	460	700
Matzoth, thin tea	2	130	Peanut, roasted in shell	0 8	740
Matzoth, whole wheat	280	420	Pear, Bartlett	2	100
Mayonnaise	600	17	Pear, canned in sirup	8	52
Milk, buttermilk, cultured	130	140	Pecan	0 2	420
Milk, dialyzed Re placed by Lonalac	-----	-----	Pepper, black, ground (spice)	16	880
Milk, evaporated	100	270	Pepper, green (vegetable)	0 5	170
Milk, goat	34	180	Pepper, red, ground (spice)	46	2,400
Milk, human, from 9 mothers, 11 to 10 days postpartum	40	61	Pepper, white, ground (spice)	5	48
Milk, human, from 4 mothers, 49 to 77 days postpartum	11	51	Persimmon, wild	0 8	340
Milk, malted	140	720	Pickle, dill	2,300	330
Milk, whole, dry	410	1,100	Pilchard See sardine	-----	-----

TABLE 124—CONT'D

FOOD	Na, MG PER 100 GM		K, MG PER 100 GM		FOOD	Na, MG PER 100 GM		K, MG PER 100 GM	
	100 GM	100 GM	100 GM	100 GM		100 GM	100 GM	100 GM	100 GM
Pineapple		0.3	210		Pum	2	3		
Pineapple, canned in syrup	1		120		Sage	19	670		
Pineapple, frozen in syrup	1		38		Salmon	48	410		
Pineapple juice, unsweetened, canned	0.4		140		Salmon, canned	470	330		
Plum	0.1		140		Salt, common The oretical value for pure NaCl	39,312	0		
Plum, canned	18		110		Sardine (herring), canned in oil	510	560		
Pomegranate, juice and pulp	0.3		200		Sardine (pilchard), canned in natural juice	760	260		
Popcorn, popped and oiled	3		320		Sardine (pilchard), canned in tomato sauce	400	320		
Popcorn, popped, oiled and salted	1,500		340		Sauerkraut, canned	730	490		
Pork, less excess fat	58		260		Sausage, Bologna	220	81		
Pork salt	2,000		260		Sausage, Frankfurt	1,100	330		
Postum (cereal bever- age), dry	36		1,300		Sausage, pork	1,100	440		
Postum, instant, dry	71		2,200		Shortening, vegetable, Crisco	4	0		
Potato chips	340		890		Shortening, vegetable, Spry	0.4	0.2		
Potato, sweet, canned	48		200		Shrimp	140	220		
Potato, sweet, less skin	4		530		Syrup, chocolate	60	130		
Potato, white, canned	350		240		Syrup, maple	14	130		
Potato, white, less skin	0.6		410		Syrup, sorghum	20	600		
Poultry seasoning	26		840		Syrup, table (corn and cane)	83	24		
Pretzel	1,100		330		Soda, baking The oretical value for pure NaHCO <sub>3</sub>	27,373	0		
Prune, canned in syrup	3		220		Sorghum syrup	20	600		
Prune, dried	5		600		Soup, beef, canned				
Prune juice, unsweetened	2		260		Diluted as served	400	244		
Pumpkin	0.4		480		Soup, tomato, canned				
Pumpkin, canned	2		240		Diluted as served	400	440		
Quail, breast meat	35		160		Soup, vegetable, canned				
Quail, leg meat	44		190		Diluted as served	150	170		
Quince	0.6		290		Soybean, dry	4	1,900		
Rabbit domesticated, foreleg	47		370		Soy flour, solvent extracted	0.6	1,700		
Rabbit, domesticated, loin	34		400		Spaghetti See Macaroni				
Ralish, with skin	8		260		Spinach	190	790		
Raisin, seedless	21		720		Spinach, canned	300	260		
Raisin, Zante	22		730		Spinach, frozen	60	330		
Raspberry, black	0.2		190		Squash, acorn	0.3	260		
Raspberry, oriental (wineberry)	0.8		170		Squash, Hubbard	0.2	240		
Raspberry, red	0.4		160		Squash, yellow summer	0.5	200		
Rhubarb, stalks	1		70		Squash, white summer	0.2	150		
Rice flakes	720		180		Starch, corn	4	4		
Rice, puffed	0.8		100		Strawberry	0.7	180		
Rice, polished and coated	2		130						
Rice vitaminized	4		170						



TABLE 124—CONT'D

	Na, MG PER 100 GM	K, MG PER 100 GM		Na, MG PER 100 GM	K, MG PER 100 GM
FOOD	100 GM	100 GM	FOOD	100 GM	100 GM
Strawberry, frozen, sweetened	2	180	Veal, less excess fat	18	330
Sugar, light brown	24	230	Vinegar, cider	1	100
Sugar, white	0.3	0.5	Vinegar, distilled	0.6	15
Tangerine	2	110	Walnut, black	2	460
Tangerine, juice sweet ened, canned	0.6	170	Walnut, English	2	450
Tapioca, granules	5	19	Water, carbonated, I	18	0.6
Tea, India Ceylon			Water, carbonated, II	1	0.6
Java blend	4	1,800	Watermelon	0.3	110
Thyme, whole	36	500	Wheat flakes	1,000	540
Tobacco, chewing	1,600	1,800	Wheat germ, con taining some bran and flour	2	780
Tomato	3	330	Wheat gluten	2	24
Tomato, canned	18	130	Wheat, puffed	3	340
Tomato juice, canned	230	230	Wheat, shredded	2	340
Tongue, beef	100	260	Wheat, winter	2	430
Tripe, pickled	46	19	Whisky, blended	0.8	1
Tuna, canned	540	480	Whisky, bonded	0.1	0.6
Turkey, breast meat	40	320	Wine, port	4	75
Turkey, leg meat	92	310	Wine, sauterne	10	87
Turneric	21	2,700	Wineberry	0.8	170
Turnip, leaves	10	440	Worcestershire sauce	1,400	360
Turnip, white	37	230	Yeast, compressed	4	360
Turnip, yellow (rutabaga)	5	260	Yeast, debittered, dry	180	1,900
Vanilla extract	1	74	Yeast, primary cultured, dry	8 to 320	2,000
			Zwieback	250	170

See also discussion by Hills et al J Am Dietet A 25 304 1948

TABLE 124 A

## MEAD JOHNSON &amp; CO PRODUCTS

	Na, MG PER 100 GM	K, MG PER 100 GM		Na, MG PER 100 GM	K, MG PER 100 GM
Alacta (half skim milk), dry	520	1,400	Lactic Acid Milk No 2, dry	400	1,100
Amigen, dry	1,600	270	Lonalac, dry	20	1,200
Amigen 5% in 5% Dextrose Solution	150	29	Lonalac, reliquefied	2	160
Amigen, 10% Solution	240	68	Nutramigen, dry	380	960
Casee (calcium caseinate)	42	21	Olac, dry	270	680
Dextrin Maltose No 1	830	220	Pabena, dry	650	500
Dextrin Maltose No 2	44	160	Pablum, dry	670	360
Dextrin Maltose No II	45	1,300	Pectin Agar in Dextrin Maltose	750	200
Dextrin Maltose with Yeast Extract			Protein Milk, dry	460	650
and Iron	52	360	Protenuum, dry	360	1,100
Lactic Acid Milk			Protolysate, dry	1,500	400
Half Skim, dry	440	1,300	Sobee, dry	430	1,300
			Yeast, brewer's	8 to 320	2,000

## Public Water Supplies

Inasmuch as the sodium content of water may be appreciable, it becomes advisable to check the value when sodium restriction is produced

d food and  
l sodium per  
d ne, and a  
a rule to  
use only distilled or deionized water for sodium restricted patients wherever the municipal supply contains more than 3 mg of sodium per 100 c c

Fortunately, the municipal water supplies of many cities are so low in sodium that they are entirely suitable for use in low sodium diets. There are, however, some outstanding exceptions. Hardness or softness has no bearing on the sodium content of water, except that when hard water is softened by base exchange apparatus the calcium and magnesium are replaced by sodium in the ratio of 2 atoms of sodium for each atom of calcium or magnesium. Therefore, water which has been softened is always suspected as regards its suitability for low sodium diets and for the preparation of reliquified Lonalac.

The following table gives the sodium (and potassium) content of the waters of representative cities. Included are the principal cities of the United States, the capitals of the states and many places important as medical centers. The samples were mostly taken in the winter and spring of 1947, and the analyses were made with the flame photometer. Seasonal variations are known to occur, especially in river waters, but river waters rarely contain much sodium.

Additional data on public water supplies can be obtained from the various state and municipal laboratories, and from a United States Government bulletin compiled some years ago "The Industrial Utility of the Public Water Supplies in the United States, 1932" (Geological Survey, United States Department of the Interior, Water Supply Paper 658, Washington, D C, Government Printing Office, 1934, order from Superintendent of Documents, 25 cents).

TABLE 124 B

PLACE	Na, MG PER 100 c c	K, MG PER 100 c c	PLACE	Na, MG PER 100 c c	K, MG PER 100 c c
Aberdeen, S D	20	2	Buffalo, N Y	0.7	0.3
Albany, N Y	0.2	0.2	Burlington, Vt	0.2	0.1
Albuquerque, N M	0.1	0.7	Carson City, Nev	0.4	0.3
Annapolis, Md	0.2	0.2	Charleston, S C	1	0.3
Ann Arbor, Mich	2	0.5	Charleston, W Va	0.3	0.2
Atlanta, Ga	0.2	0.2	Charlotte, N C	0.3	0.1
Augusta, Maine	0.2	0.2	Charlottesville, Va	0.2	0.1
Austin, Texas	3	0.5	Cheyenne, Wyo	0.3	0.2
Baltimore, Md	0.3	0.2	Chicago, Ill	0.3	0.1
Bangor, Maine	0.2	0.1	Cincinnati, Ohio	0.7	0.3
Baton Rouge, La	9	0.2	Cleveland, Ohio	1	0.3
Beloit, Wis	0.5	0.2	Columbia, S C	0.4	0.2
Biloxi, Miss	23	0.6	Columbus, Ohio	5	0.6
Birmingham Ala	0.1	0.3	Concord, N H	0.2	0.1
Bismarck, N D	6	0.6	Crandall, Texas	170*	0.5
Boise, Idaho	2	0.3	Dallas, Texas	3	0.5
Boston, Mass	0.3	0.2	Denver, Colo	0.1	0.2
Brownsville, Texas	6	0.3	Des Moines, Iowa	1	0.4

\* An extreme example. This water is rarely drunk but is used for cooking.

TABLE 124 B—CONT'D

PLACE	Na, MG PER 100 cc	K, MG PER 100 cc	PLACE	Na, MG PER 100 cc	K, MG PER 100 cc
Detroit, Mich	03	01	Nashville, Tenn	03	02
Dover, Del	2	05	Nevada, Mo	43	07
Durham, N C	04	02	Newark, N J	02	01
El Paso, Texas	7	06	New Haven, Conn	03	01
Ephrata, Pa	03	02	New Orleans, La	1	04
Evansville, Ind	2	05	New York, N Y	03	02
Fargo, N D	■	07	Oakland, Calif	03	01
Frankfort, Ky	03	01	Oklahoma City, Okla	10	08
Galesburg, Ill	30	2	Olympia, Wash	05	03
Galveston Texas	34	07	Omaha, Neb	8	1
Harrisburg, Pa	02	01	Philadelphia Pa	3	04
Hartford, Conn	02	01	Phoenix, Ariz	11	07
Helena, Mont	03	02	Pierre, S D	■	05
Houston, Texas	16	06	Pittsburgh, Pa	6	05
Huntington, W Va	3	02	Portland, Maine	02	01
Indianapolis, Ind	1	03	Portland, Ore	01	01
Iowa City, Iowa	05	03	Providence, R I	02	01
Jackson, Miss	04	02	Raleigh, N C	04	01
Jacksonville Fla	1	02	Reno, Nev	05	01
Jefferson City, Mo	3	04	Richmond, Va	07	02
Jersey City, N J	03	02	Rochester, Minn	07	02
Kansas City, Kan	4	04	Rochester, N Y	03	02
Kansas City, Mo	10	3	Sacramento, Calif	03	02
Lansing, Mich	1	05	Santa Fe, N M	04	01
Lincoln, Neb	3	07	St Louis, Mo	5	05
Little Rock, Ark	01	01	St Paul, Minn	05	03
Los Angeles, Calif			Salem, Ore	02	01
Aqueduct source	6	06	Salt Lake City, Utah	08	02
Metropolitan			San Diego, Calif	5	05
source	17	06	San Francisco, Calif	1	03
River source	5	05	Seattle, Wash	02	01
Louisville, Ky	2	03	Sioux Falls, S D	1	04
Madison, Wis	04	02	Springfield, Ill	08	03
Manchester, N H	02	01	Syracuse, N Y	02	01
Marion, Ohio	17	07	Tallahassee, Fla	03	01
Memphis Tenn	2	03	Topeka, Kan	1	05
Miami, Fla	2	03	Trenton, N J	01	01
Milwaukee, Wis	03	01	Tucson, Ariz	3	03
Minneapolis, Minn	05	03	Washington, D C	03	03
Minot, N D	25	06	Wichita, Kan	5	05
Montgomery, Ala	08	01	Wilmington Del	08	01
Montpelier, Vt	01	01			

TABIE 121

SODIUM CHLORIDE CONTENT OF FOOD

Salt (differentiated from sodium) adjustment is necessary in several conditions, and while the sodium chloride content, and the content of any other mineral of a food varies with the variety, mode of preparation and environmental conditions under which grown, it is possible to approximate the content of the natural food

All corned, pickled, smoked, and salted foods have a high sodium chloride content

Bananas, bread, butter, crackers, egg white, meat stock, meat broth, meat extracts, cheese and milk, molasses, and oysters are rich sources of sodium chloride

Cereals, fruits, and vegetables, in general, are poor sources

For sodium content of foods see Table 121

Approximate values are given for some common foods

KIND OF FOOD	GM NaCl PER 100 GM NATURAL FOOD
<i>Cereals and Cereal Products</i>	
Barley	0.04
Bread, white	0.70-1.0
Corn	0.30
Macaroni	0.7-1.04
Oats, rolled	0.10-0.35
Rice	0.04
Rye	0.015
<i>Dairy Products</i>	
Butter, salted	1.0-3.0
Cheese	1.0-5.0
Egg, yolk	0.04
Egg, white	0.31
Milk	0.18-0.25
<i>Fish</i>	
Cod, fresh	0.16
Coil, salt	3.4
Haddock	0.39
Pickarel	0.10
Salmon	0.12
<i>Fruits</i>	
Apricots	0.005
Grapes	0.025
Pineapple	0.07
Plums	0.005
Raisins	0.16
Strawberries	0.19
Watermelon	0.01
<i>Meats</i>	
Bacon	1.0
Beef	0.11
Chicken	0.14
Goose	0.20
Liver, calf	0.14
Mutton	0.17
Pork	0.10
Veal	0.13

TABLE 125—CONT D

KIND OF FOOD	GM NaCl PER 100 GM NATURAL FOOD
<i>Miscellaneous, prepared in the usual way</i>	
Beef broth	0 73
Chicken soup	0 50
Pea soup	0 35
Soup stock	0 76
<i>Vegetables</i>	
Asparagus, fresh	0 04 0 06
Asparagus, canned	0 83
Beans, fresh	0 09
Beans, canned	0 77
Cabbage, fresh	0 03 0 75
Cauliflower	0 05 0 15
Celery	0 2 0 5
Lettuce	0 1
Onion	0 02 0 30
Peas, fresh	0 06
Peas, canned	0 67
Potato	0 10 0 15
Tomato	0 10

TABLE 126

## FOODS CONTAINING OXALIC ACID\*

Beet greens	Purslane
Gooseberries	Rhubarb
Lamb's quarters	Spinach
Poke	Swiss chard
Poppy seed	

\*Kohman Oxalic Acid in Foods J Nutrition 16 233 1939

TABLE 127

## LIST OF A FEW FOODS AND THE POSSIBLE ALLERGENS THEY CONTAIN\*

*Baby Foods*

Borden's Malted Milk	Barley, malt wheat flour, whole milk
Carnick's Soluble Food	Malted wheat, dried milk, milk sugar
Dryco Rice "polish,"	vitamin B, irradiated milk
Farina Wheat	
Horhek's Malted Milk	Barley, wheat flour, desiccated milk, malt,
	haze syrup (corn syrup)
Mellin's Food	Wheat flour, wheat bran, malted barley
Moore's Food	Wheat, malt
Nestle's Food	Malted whole wheat malt, dry milk, wheat flour, cod
	liver oil
Pabulum	Wheat meal, oatmeal, corn meal, yeast, beef bone, iron, salt
Similac	Butter fat, olive oil, coconut oil, cod liver oil

\*Alexander Harry L Synopsis of Allergy St Louis 1941 The C V Mosby Company

*Beverages (Nonalcoholic)*

- Coca Cola** Caffein caramel essential oils (cinnamon, coriander, lemon, neroli, nutmeg, sweet orange) glycerin, lime juice, phosphoric acid cocoa leaves or kola nuts
- Ginger Ale** Ginger, lemon sometimes capsaicum
- Root Beer** Caramel oils of anise, birch, cassia cloves, lemon, sagefras, wintergreen coumarin, and vanilla
- Sarsaparilla** Caramel, cologne spirits, oils of anise, orange, sagefras wintergreen, powdered pumice stone

*Beverages (Alcoholic)*

- Beer (Ale, Stout, Porter)** Fermented malted grain, usually barley, wheat, rye oats, rice, and corn may be used Hops are usually added
- Brandy** Grapes peaches cherries apples, and other fruits
- Gin** Barley, malt rye and corn, flavored with juniper berries, angelica root, calamus carlambon, cassia, cinnamon, coriander, fennel, grains of paradise licorice, orris root
- Whiskey** Malt, corn, rye, and other cereals
- Wines** Usually grapes other fruits

*Breads*

- Glazed crusts contain white of egg
- Buckwheat flour is used on the bottom of all breads to prevent burning
- Buckwheat Bread** Buckwheat, wheat, yeast
- Kommisbrot** Rye
- Pumpernickel** Rye graham flour (20%) bleached clear flour (80%), malt (0.1%)
- Rye Bread** Rye flour (25%) bleached clear flour (75%) yeast
- Schwarzbröt** Coarse rye flour
- White Bread** Bleached patent flour yeast, malt, eggs, vegetable oil, butter
- Whole Wheat Bread** Bleached patent flour whole wheat flour, eggs, caramel
- Corn Flakes** Corn malt
- Cream of Wheat** Entirely wheat
- Farina** Wheat
- Grape Nuts** Wheat malted barley yeast
- Macaroni** Wheat milk
- New Pettigohn's** Wheat
- Nutro** Wheat peanut flour
- Post Toasties** Corn
- Postum Cereal** Wheat bran molasses
- Post's Bran** Wheat bran malt syrup
- Quaker Crackles** Corn wheat oats
- Ralston's Health Breakfast Food** Wheat
- Roman Meal** Flaxseed
- Spaghetti** Wheat and milk

*Prepared Flours*

- Aunt Jemima's Pancake Flour** Wheat corn, rice rye, milk
- Aunt Jemima's Buckwheat Flour** Corn wheat buckwheat
- H O Co Buckwheat Pancake Flour** Cornmeal, buckwheat, wheat
- Purina Health Pancake Flour** Wheat, corn

Uncle Jerry's New England Corn and Rice Pancake Flour    Corn, wheat,  
potato, rice, leavening  
Uncle Jerry's New England Self Raising Buckwheat Flour    Buckwheat  
wheat corn, leavening

### *Desserts*

Blancmange    Irish moss, milk, flavoring  
Custard    Egg milk, flavoring  
Fritters    Flour egg milk  
Gelatin    Cow, sheep goat pig and fish hides and connective tissue  
Ice Cream    Egg milk, flavoring  
Ices    Fruit egg flavoring  
Meringue    Egg, lemon

### *Pantry Supplies*

Beef Juices    Meat egg  
Canned Tomato Soup    Tomato, butter, onion, wheat, spices  
Catsup    Tomato spices, onion  
Cottolene    Cottonseed oil, beef suet  
Crisco Spry Fluffo    Cottonseed oil  
Noodles    Wheat egg  
Potato Chips    Potato cottonseed oil

## TABLE 128

### **Recipes for Use in Allergy**

#### **(1) Chicken Croquettes**

1 tbs oil or chicken fat	$\frac{1}{2}$ c liquid (chicken broth)
2 tbs cornstarch	$\frac{3}{4}$ # cooked minced chicken
	salt

Make a sauce of fat, cornstarch, and liquid. Add the other ingredients (Cooked corn meal may be added). Cool. Shape and dip in rye flour or crushed corn flakes. Bake in medium oven or fry in deep fat.

#### **(2) Corn Pones\***

1 c corn meal	boiling water
$\frac{1}{2}$ tsp salt	1 tbs Mazola oil

Carefully pour enough boiling water onto the corn meal to make a stiff mixture, stirring constantly. Add the oil and mix well. Mold into oblong 'pones' and fry in hot skillet with enough fat to prevent sticking. When brown on one side, turn and brown on the other side. Serve hot.

\*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet. Baking powder should be Royal or Schill ing which contains no egg.

## (3) Corn and Rice Muffins\*

$1\frac{1}{2}$ c rice flour	$2\frac{1}{2}$ tsp baking powder
$\frac{1}{2}$ c yellow corn meal	3 tbs Mazola oil
2 tbs sugar	$\frac{1}{2}$ c water

Mix all the dry ingredients well, sifting them together four or five times. Add the water and oil. Bake in a hot oven for 20 minutes. Makes 6 small muffins.

## (4) Corn and Rye Muffins\*

Use recipe for Corn and Rice Muffins, but substitute rye flour for rice flour.

## (5) Rice Biscuits

Made by the Battle Creek Sanitarium, Battle Creek, Mich.

## (6) Rice Bread\*

1 c rice flour	1 tbs sugar
2 tsp baking powder	$\frac{1}{2}$ tsp salt
2 tbs lard or fat or oil	$\frac{1}{2}$ c water

Sift the dry ingredients. Add water and fat. Bake in a loaf pan in a moderate oven.

## (7) Rye Rice Bread\*

$\frac{1}{2}$ c rye flour	6 tsp sugar
$\frac{2}{3}$ c rice flour	5 tsp baking powder
$\frac{1}{2}$ tsp salt	2 tsp olive oil
$1\frac{1}{2}$ c water	

Sift all the dry ingredients together. Add water and oil. Bake in a loaf pan in a moderate oven for 40 minutes.

## (8) Ry Krisp

Prepared by the Ralston Purina Company, St. Louis, Mo.

## (9) Pear Butter

Select firm, ripe pears. Wash, core, and cut into rather small pieces. To 2 c of prepared fruit, add 1 c sugar. Cook slowly, stirring frequently to prevent burning for 2 hours or until the mixture is quite thick.

\*Fat used in recipes for biscuits, muffins or shortening must be only oil or fat specified in the prescription list. Baking powder should be Roca or Schill's which contains no egg.



## (10) Rice Fruit Pudding Sauce

1 c sugar	1¼ c boiling water
2 tbs rice flour	1 tsp lemon juice or vanilla
	½ tsp salt

Mix sugar, salt, and cornstarch. Add water and cook until thick. Remove from stove and add flavoring. Add boiled rice and apricots or sliced peaches and serve warm. Reserve some sauce to pour over the pudding.

## (11) Tapioca-Fruit Pudding

2 halves peaches sliced	2 tsp sugar
1 tbs dry tapioca	½ c peach juice and water

Drain peaches and sprinkle with 1 tsp sugar. Cook tapioca in juice and water until it is clear. Add remaining sugar and salt. Line a baking dish with peaches. Fill with tapioca and bake in a moderate oven for 20 minutes.

## (12) Rice Cup Cakes\*

¾ c hot water	¼ c sugar
1½ c rice flour	¼ tsp salt
2 level tbs shortening	3 level tsp baking powder
	1 tsp vanilla

Pour hot water over half the flour. Cream sugar and shortening and add to the above mixture, beating well. Add the other ingredients, mixing well. Bake in muffin pans for about 20 minutes in a fairly hot oven.

## (13) Lamb Patties

Ground lamb pressed into small patties. Broiled or fried.

## (14) Puffed Rice Candy

1 c sugar	¼ tsp salt
½ c brown sugar	1 tsp vanilla
1 c water	Puffed rice

Cook sugar, syrup, and water until brittle. Add vanilla and salt. Pour puffed rice, stirring all the time so that the kernels will be evenly coated. Turn it into a greased pan and cut in squares. Keeps well in an airtight container.

## (15) Tomatoes Cooked With Sugar

Select firm, ripe tomatoes. Remove the skins, cut in slices, and drain an hour or more. For each cup of tomatoes add a cup of sugar and boil until thick, stirring often. Sliced lemon may be added to the tomatoes while cooking.

\*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet. Baking powder should be Royal or Schill, which contains no egg.

## (16) Chicken and Pineapple Salad

Cut cold boiled chicken into cubes and marinate for 2 hours in French dressing of oil and white vinegar and salt. Drain well, mix chicken with about one third its volume of diced pineapple, and add special mayonnaise, thinned with pineapple juice to taste.

## (17) Split Pea Soup

1 $\pi$ split peas	diced bacon (crisp)
1 tbs bacon fat	salt

Cook the peas until they form a smooth purée. Just before serving, add salt, bacon fat, and crispy fried bacon.

## (18) Rye or Rice Cookies

1 $\pi$ rye or rice flour	$\frac{1}{2}$ tsp soda
$\frac{1}{2}$ $\pi$ light molasses (or syrup)	$1\frac{1}{2}$ tsp baking powder
3 tbs Wesson oil	1 tbs sugar
$\frac{1}{4}$ tsp salt	Water to make a stiff dough

Mix dry ingredients. Add syrup, oil, and water. Drop on a greased cookie sheet and bake at 325° F for 15 minutes.

## (19) Fruit Cornstarch Pudding

$1\frac{1}{2}$ c fruit pulp	2 tsp sugar
$1\frac{1}{2}$ $\pi$ water	5 level tsp cornstarch

Cook for  $\frac{1}{2}$  hour in the top part of a double boiler.

## (20) Tapioca With Apricots

6 halves apricots, puréed	1 tbs dry tapioca
2 tsp sugar	$\frac{1}{2}$ c juice and water

Cook the liquid and tapioca in a double boiler until tapioca is clear. Add apricots and blend well. Serve warm with apricot juice.

## (21) Lima Bean Potato Muffins or Bread\*

$\frac{2}{3}$ c potato flour	$\frac{1}{2}$ tsp salt
$\frac{1}{2}$ c Lima bean flour	4 tsp sugar
3 tsp baking powder	$\frac{1}{2}$ c water
2 tbs shortening	

Sift dry ingredients together. Melt fat and add to water, add slowly to dry ingredients. Put in greased muffin tins and bake at 400° F for 20 minutes. Serve hot. Makes 10 small muffins.

\*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet. Baking powder should be Royal or Schilling which contains no egg.

## (22) Lima Bean Soya Bean Bread

Substitute soya bean flour for potato flour in recipe for potato Lima bean bread

## (23) Boiled Mayonnaise

1 tsp sugar	juice of 1 large lemon
$\frac{1}{2}$ tsp salt	$\frac{3}{8}$ c boiling water
3 level tsp starch*	$\frac{1}{2}$ c Mazola oil

Mix sugar, salt, starch, and lemon juice. Add water, cook until thick. Remove from stove and slowly add oil, beating vigorously.

## (24) Purée of Lima Bean Soup

Wash and soak, for a few hours, 2 = Lima beans. Cook in plenty of water salted to taste. When beans are well done, put through a sieve.

Cook small pieces of bacon, crisp. Add enough bacon dripping and crisp fried bacon to purée to make palatable.

## (25) Lima Bean Potato Cake or Cookies†

6 lbs Lima bean flour	$2\frac{1}{2}$ tsp baking powder
$\frac{3}{4}$ c potato flour	$\frac{1}{2}$ tsp vanilla
5 lbs shortening	$\frac{1}{2}$ tsp lemon extract
$\frac{1}{2}$ c water	few grains salt
$2\frac{1}{2}$ = sugar	few drops yellow coloring

Sift dry ingredients, cream fat and sugar, add dry ingredients and water alternately to creamed mixture. Add flavorings and coloring. Put in greased muffin tins and bake in oven at 430° F for 10 minutes.

## (26) Penuche Frosting

3 c brown sugar	$\frac{1}{4}$ c water
-----------------	-----------------------

Boil sugar and water until soft ball is formed when tested in cold water. Remove from heat, cool, and beat until creamy. An extra tablespoonful of water may be added if necessary for easy spreading. White sugar may be used instead of brown, and vanilla or lemon flavoring may be added. Chopped fruit may also be added if desired.

## (27) Carrot Marmalade

5 very large carrots	sugar
4 lemons	10 c water

Squeeze juice and add later. Remove all seeds. Then grind lemons and carrots together. Add water. Boil all this together for a good half hour, then measure it cup for cup of pulp and sugar. Boil slowly for an hour, or until it jells. Lemons vary slightly in congealing time.

\*Use rice flour in Diet 1, cornstarch in Diet 2, and potato flour in Diet 3.  
†Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet. Baking powder should be Royal or Sculling which contains no egg.

## TABLE 129

## SYMBOLS AND ABBREVIATIONS

Ad lib—as desired ( <i>ad libitum</i> )	hr—hour
Avoir—avoirduois	ht—height
bl, bbl—barrel	1 d—daily (in d c)
BH/NH—Bureau Human Nutrition and Home Economics	1 l l—in the same place ( <i>illic</i> )
BM—basal metabolism or bowel movement	1 d—the same ( <i>idem</i> )
BMR—basal metabolic rate	in—inches
BP—bolting point	I U—International unit
bu—bushel	kg, kgm, kilo—kilogram
C—carbon	kl—kiloliter
C—centigrade, carbohydrate	km—kilometer
c—cup	L—liter
Ca—calcium	lb—pound ( <i>libra</i> )
cal—calorie	liq—liquor
cap—capsule	M—1000
cc—cubic centimeter, also occasion- ally written cu cm	Mg—magnesium
cent—centigrade (centum meaning 100)	mg—milligram
cg, cgm—centigram	μg, meg—microgram
Cl—chlorine, chlorine	mm—millimeter
cm—centimeter	ml—milliliter or cc
CP—chemically pure	mm—millimeter
cryst—crystallized crystalline	Ma—manganese
Cu—copper	N—nitrogen
cu—cubic	Na—sodium ( <i>natrum</i> )
1000	Ni—nickel
decoct—decoction	No—number
	noct—at night ( <i>nocte</i> )
	O—oxygen
	om—every morning ( <i>omni mane</i> )
	ol—oil ( <i>oleum</i> )
	os—mouth ( <i>ostium</i> )
	oz—ounce
	P—phosphorus
	P—protein
	pc—after a meal ( <i>post cibum</i> )
dim—one half ( <i>dimidius</i> )	pH—in lex of acidity or alkalinity
dr—dram	pl—pill
dsp—dessert spoon	pk—peck
ea—each	pond—by weight ( <i>pondere</i> )
eg—for example	ppt—precipitate
et al—and others ( <i>et alibi</i> )	prn—when required ( <i>pro re nata</i> )
et seq—and the following	pt—pint
F—fluorine, fluorin	pulv—powder ( <i>pulvis</i> )
F—Fahrenheit, fat	qd—four times daily ( <i>quater in die</i> )
Fahr—Fahrenheit	qh—every hour ( <i>quaque hora</i> )
Fe—iron	ql—as much as one pleases ( <i>quan- tum libet</i> )
flt—filter	qt—quart
fl dr—fluid dram	RQ—respiratory quotient
fl oz—fluid ounce	R—recipe, prescription
gal—gallon	S—sulphur (sulfur)
γ—gamma	sat—saturated
gr—gill	SDA—specific dynamic action
gm—gram	sig—let it be labeled ( <i>signetur</i> )
gr—grain	sol—solution
gtt—drop ( <i>guttae</i> )	solv—dissolve (solve)
H—hydrogen	
Hb—hemoglobin	

TABLE 129—CONT'D

sp gr—specific gravity	t	{ (written as small t to differentiate from T )
spk—speck	III	
sq—square	tsp	teaspoon
ssp—salt spoon	u—unit	
stat—immediately ( <i>statim</i> )	ur—urine	
sym—symmetric	USDA—United States Department of Agriculture	
syr—syrup ( <i>sirup</i> )	USP—United States Pharmacopoeia	
T—temperature	v—volume	
tab—tablet	vehic—vehicle	
T	wg—water glass	
{ (written with a capital to differentiate from a small t )	wt—weight	
	Zn—zinc	
tb	<—less than	
tbs	>—more than	
tbsp		
t i d—three times daily ( <i>ter in die</i> )		
tinct—tincture		

TABLE 130

## TABLE OF WEIGHTS AND MEASURES AND CONVERSION VALUES

- 1 cc = approximately 1 gm or 16 minims 1 min  $\approx$  0.06 cc  
 A minim and a drop (gtt) are usually considered to be of equal size  
 However, the size of the drop is dependent on the bore of the dropper One cubic centimeter, therefore, may contain from 12 to 20 drops or even 50 as in the dropper accompanying A D vitamin concentrates  
 Whether the cubic centimeter and gram are equivalent will depend upon the specific gravity (sp gr) of the liquid
- 1 standard tsp = 5 cc  
 Unfortunately, the old value of 4 cc continues to be used in many medical and pharmaceutical texts Teaspoons today contain 5 cc, and not 4 cc, as they did many years ago A 4 cc teaspoon can be found in silver sets of two generations ago or currently as a "five o'clock teaspoon" It is not a spoon in general use This old teaspoon is equivalent to 1 fl dr
- 1 dsp = 2 tsp  
 1 tbs =  $\frac{1}{2}$  fl oz = 4 drams = 15 cc  
 1 c = 16 tbs = 8 fl oz = 237 cc (approx 240 cc) = 2 gills =  $\frac{1}{2}$  pint  
 2 c = 1 pt  
 2 pt = 1 qt  
 1 qt = 0.946 L  
 1 L = 1.056 qt or 1,000 cc  
 4 qt = 1 gal  
 8 qt = 1 pk  
 4 pk = 1 bu  
 1 dr =  $\frac{1}{8}$  fl oz, 3.696 cc (approx 4 cc)  
 7.29 dr = 1 oz  
 1 fl oz = 29.574 cc (approx 30 cc or 2 tbs)  
 1 gr = 0.065 gm  
 1 gm = 15 gr  
 1 oz = 28.35 gm (approx 30 gm)  
 1 lb = 453.6 gm (approx 450 gm)  
 1 kilo = 2.2 lb  
 1 lb = 0.454 kilo

14 lb = 1 stone  
 1 stone = 6.35 kilo  
 10 mg = 1 cg  
 100 cg = 1 gm (A Buffalo nickel weighs 5 gm)  
 1,000 g = 1 kg or kilo  
 2.5 cm = 1 in  
 40 in = 1 meter

*Conversion Table\**

gr  $\times$  0.065 = gm

gm  $\div$  15 = gr

in  $\times$  2.5 = cm

cm  $\div$  2.5 = in

oz  $\times$  30 = gm

gm  $\div$  30 = oz

lbs  $\times$  2.2 = kilo

kilo  $\div$  2.2 = lbs

Freezing  $0^{\circ}$  C or  $32^{\circ}$  F

Body temperature  $37^{\circ}$  C or  $98.6^{\circ}$  F

Boiling  $100^{\circ}$  C or  $212^{\circ}$  F

Fahrenheit to Centigrade—subtract 32 from 212 so that freezing points

correspond then  $180^{\circ}$  F =  $100^{\circ}$  C, or  $1^{\circ}$  F =  $\frac{100}{180}$  or  $\frac{5}{9}$  or 0.55 C,

therefore the F figure  $- 32 \times \frac{5}{9}$  or 0.55 = C, the C value  $\times 9$ , or  $1.8 + 32 = F$

Example  $(98.6^{\circ}$  F  $- 32) \frac{5}{9} = 37^{\circ}$  C

\*For exact conversion values see exact figure given above

TABLE 131  
FOOD COMPOSITION TABLE FOR SHORT METHOD OF DIETARY ANALYSIS\*  
*Ella G Donelson and Jane M Leitch-Stearns*  
*Division of Home Economics, University of Minnesota, St Paul*

The estimation of the nutritive value of a diet, following the usual procedure in which separate computations are made for each food item, assumes a greater degree of accuracy than is justified when the wide variation in composition of any given food is taken into consideration. In view of this, a short method of dietary analysis was developed in which foods of similar composition were grouped together and mean values for each of the nutrients established.

The accuracy of the values in this food composition table was tested on a series of 30 three day diet records. These were computed first by the usual method whereby each individual food item is calculated separately, and then using the revised composition table. Comparison of the results secured by the two methods showed a high degree of accuracy for the values in the food composition table. When tested statistically the observed differences were shown to be due to errors in random sampling and not to real differences between the two methods.

FOOD	APPROXIMATE MEASURE	WT G	CALORIES	PROT G	FAT G	CARBOHYDRATE G	CS G	GN G	Fe MG	NI MG	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG
Cereal products refined	1 sl bread (30 gm), 4 c cooked cereal and cereal products (20 gm dry), 1 c prep cereal (30 gm), 3 c crackers (20 gm), 1 c, pop corn (20 gm), 1 griddle cake	80	25	1	15	01	03	2	—	—	02	02	2
whole grain and un riched	1 sl bread (30 gm), 4 c cooked cereal (20 gm dry), 1 c prep cereal (30 gm), 3 graham crackers (20 gm)	80	25	1	15	01	04	6	—	—	06	04	6

\*Reprinted from Journal of the American Dietetic Association #1 No. 7 July August, 1940, by permission.









TABLE 132  
WEIGHT HEIGHT AGE TABLE FOR GIRLS  
From Birth to School Age

HEIGHT (INCHES)	1 MO	3 MO	6 MO	9 MO	12 MO	18 MO	24 MO	30 MO	36 MO	48 MO	60 MO	72 MO
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14	14								
25	13	14	15	15								
26		15	16	17	17							
27		16	17	18	18							
28			19	19	19	19						
29			19	20	20	20						
30			21	21	21	21	21					
31				22	22	23	23	23				
32					23	24	24	24	25			
33						25	25	25	26			
34						26	26	26	27			
35						29	29	29	29	29		
36							30	30	30	30	31	
37							31	31	31	31	32	
38								33	33	33	33	
39								34	34	34	34	34
40									35	36	36	36
41										37	37	37
42										39	39	39
43										40	41	41
44											42	42
45												45
46												47
47												50
48												52

Prepared by Robert M. Woodbury Ph.D. Children's Bureau U. S. Department of Labor 1923

Weight is stated to the nearest pound height to the nearest inch age to the nearest month

Weights of children under 35 inches were taken without clothing those of children above 35 inches with clothing (shoes coat and sweater removed)

Published by American Child Health Association 50 West Fiftieth Street New York

TABLE 133  
WEIGHT HEIGHT AGE TABLE FOR BOYS  
From Birth to School Age

HEIGHT (INCHES)	1 MO	2 MO	3 MO	4 MO	5 MO	6 MO	7 MO	8 MO	9 MO	10 MO	11 MO	12 MO
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14									
25	13	14	15	16								
26		15	17	17	18							
27		16	18	18	19							
28			19	19	20	20						
29			20	21	21	21						
30			--	22	22	22	23					
31				23	23	23	23	24				
32				24	24	24	25	25				
33					26	26	26	26	26			
34						27	27	27	27			
35						28	28	29	29	29		
36							29	30	31	31		
37								31	32	32	32	
38								32	33	33	34	
39								33	34	35	35	
40									35	35		
41										36	36	36
42										37	37	37
43										38	38	38
44										39	39	39
45										40	40	40
46											41	41
47											42	42
48											43	43
49											44	44
50											45	45
51											46	46
52											47	47
53											48	48
54											49	49
55											50	50

Prepared by Robert M. Woodbury, Ph.D., Children's Bureau, U. S. Department of Labor, 1924.

Weighting children is a means of ascertaining their rate of growth. All children should make a regular annual gain. Tables 16 to 30 [of the original publication] should be used as a means of interesting parents in their children's growth.

Try infant on table on which has been placed an accurate measure. Stand child with heels and shoulders against a wall upon which has been marked or fastened an accurate measure.

Encourage the annual physical examination of every child by a physician.

TABLE 134  
WEIGHT-HEIGHT-AGE TABLE FOR GIRLS

HEIGHT INCH	5 YR.	6 YR.	7 YR.	8 YR.	9 YR.	10 YR.	11 YR.	12 YR.	13 YR.	14 YR.	15 YR.	16 YR.	17 YR.	18 YR.
38	33	33												
39	34	34												
40	36	36	36											
41	37	37	37											
42	39	39	39											
43	41	41	41	41										
44	42	42	42	42										
45	45	45	45	45	45									
46	47	47	47	48	48									
47	49	50	50	50	50	50								
48		52	52	52	52	53	53							
49		54	54	55	55	56	56							
50		56	56	57	58	59	61	62						
51			59	60	61	61	63	65						
52			63	64	64	64	65	75						
53			66	67	67	68	68	67	71					
54				69	70	70	71	69	73					
55				72	74	74	74	71	77	78				
56					76	78	78	79	81	83				
57					80	82	82	82	84	86	92			
58						84	86	86	88	93	96	101		
59						87	90	90	92	96	100	103	104	
60						91	95	95	97	101	105	108	109	111
61							99	100	101	105	108	112	113	116
62							104	105	106	109	113	115	117	118
63								110	110	112	116	117	119	120
64								114	115	117	119	120	122	123
65								118	120	121	122	123	125	126
66									124	124	125	128	129	130
67									128	130	131	133	133	135
68									131	133	135	136	138	138
69										135	137	138	140	142
70										136	138	140	142	144
71										138	140	142	144	145

Prepared by Bird T Baldwin Ph D and Thomas D Wood MD

When taking measurements remove the child's outdoor clothing shoes and coat. Take heights with a square consisting of two flat pieces of wood joined at right angles (a chalk box will serve). The child is placed in a good erect position with heels and shoulders against the wall or wide board upon which has been marked or pasted an accurate measure. Age is taken to the nearest birthday.

Published by The American Public Health Association 50 West Fiftieth Street New York N Y

TABLE 135  
WEIGHT HEIGHT AGE TABLE FOR BOYS

HEIGHT INCHES	5 YR	6 YR	7 YR	8 YR	9 YR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR	17 YR	18 YR	19 YR
38	34	4													
39	35	35													
40	36	36													
41	38	38	38												
42	39	39	39	39											
43	41	41	41	41											
44	44	44	44	44											
45	46	46	46	46	46										
46	47	48	48	48	48										
47	49	50	50	50	50	50									
48		52	53	53	53	53									
49		55	55	55	55	55	55								
50		57	58	58	58	58	58	58							
51			61	61	61	61	61	61							
52			63	64	64	64	64	64	64						
53			66	67	67	67	67	68	68						
54				70	70	70	70	71	71	72					
55				72	72	73	73	74	74	74					
56				75	76	77	77	77	78	78	80				
57					79	80	81	81	82	83	83				
58					83	84	84	85	85	86	87				
59						87	88	89	89	90	90	90			
60						91	92	92	93	94	95	96			
61							95	96	97	99	100	103	106		
62							100	101	102	103	104	107	111	116	
63							105	106	107	108	110	113	118	123	127
64								109	111	113	115	117	121	126	130
65								114	117	118	120	122	127	131	134
66									119	122	125	128	132	136	139
67									124	128	130	134	136	139	142
68										134	134	137	141	143	147
69										137	139	143	146	149	152
70										143	144	145	148	151	155
71										148	150	151	152	154	159
72											153	155	156	158	163
73											157	160	162	164	167
74											160	164	168	170	171

Prepared by Bird T. Baldwin, M.D., and Thomas D. Wood, M.D.

These tables were constructed for normally healthy children most age weight for height and age and height normally show with and depth of the skeletal frame as height in a term baby interpreting the significance of deviation from average weight for height Weight for height alone is not a reliable index of nutritional status (February 1932.)

TABLE 136

## TERMINAL STERILIZATION PROCEDURE FOR FORMULA PREPARATION

Strong Memorial Hospital—Rochester Municipal Hospital  
Rochester, New York

*Hints on Easy Formula Preparation*

- 1 Use the same equipment every day Use it only for the formula Keep everything for the formula together Make the formula the same way every day
- 2 After the feeding fill nursing bottle with cold water, rinse the nipple, and squeeze cold water through holes of nipple

*Equipment (all should be clean)*

- 1 Large enamel pail with tight cover
- 2 Bottle rack (a clean folded dish towel may be used instead of a rack, if neces ary)
- 3 Sufficient nursing bottles, nipples, and caps for each feeding for 24 hours
- 4 Sufficient nursing bottles, nipples, and caps for orange juice and water feedings for 24 hours
- 5 1 Tablespoon (or set of measuring spoons)  
1 teaspoon
- 6 Measuring cup
- 7 1 knife
- 8 Funnel
- 9 Can opener or punch if canned milk is used
- 10 Mixing pan
- 11 Metal kitchen tongs, if available

*Method*

- 1 Wash your hands Put on a clean apron
- 2 Wash bottles nipples and caps in warm, soapy water using a bottle nipper brush Rinse well and drain
- 3 Boil nipples and caps for three minutes
- 4 Measure sugar into mixing pan
- 5 Measure cold water from faucet into mixing pan Stir to dissolve sugar
- 6 Wash top of can or bottle Open can with can opener or punch Measure milk and add to mixing pan Stir thoroughly
- 7 Pour measured amount of formula for one feeding into each bottle
- 8 Close each bottle with boiled nipple Do not touch the tip of the nipples If pasteurized milk is used, place a piece of gauze across the top of each bottle held in place by the nipple
- 9 Cover nipples with cap, leaving cap tilted slightly so steam can get to nipple If you do not have caps, use paper caps made from clean wrapping or wax paper tying them loosely in place with string so that steam can get to nipple.
- 10 Put filled and capped bottles into pail
- 11 The bottles of drinking water and the empty bottle for orange juice can be put in at the same time
- 12 Fill pail with warm water up to the level of two inches
- 13 Place on stove, and when water is boiling, allow to boil for 15 minutes Have cover tight on pail
- 14 Take pail off stove Cool bottles by pouring cool water slowly down side of pail to height of formula level in bottle Do not let water splash on caps or come up around nipple and covers
- 15 Remove and place in a pan of cold water up to level of formula Tighten caps
- 16 If pasteurized milk is used shake bottles gently during early cooking period to help eliminate scum

TABLE 137

## PROTEIN IN RELATION TO GROWTH RATE

ANIMAL	DAYS REQUIRED TO DOUBLE BIRTH WEIGHT	PROTEIN %	TIME %	PHOSPHORIC ACID %
Man	180	16	0.28	0.473
Horse	60	20	1.210	1.310
Cow	47	35	1.000	1.970
Goat	39	43	2.100	3.220
Pig	18	59	—	—
Sheep	30	65	2.720	4.120
Dog	8	71	4.530	4.930
Cat	7	95	—	—

TABLE 174—COMPOSITION OF FOODS, COMMON HOUSEHOLD UNITS

This table (Table 3 in the original publication), together with the following introduction is reprinted by permission from *Composition of Foods—Raw, Processed, Prepared*, U S Department of Agriculture Handbook No 8 by Bernice K Watt and Annabel L Merrill

## Explanation of Table

This table is useful in estimating nutrient values of unweighed portions of foods as served and in rating individual diets in certain types of dietary surveys. For many foods the unit shown is 1 cupful because this quantity can be adjusted readily to servings of various sizes. For some foods, the unit shown is a given number of ounces if that approaches a reasonable portion or serving and information is lacking for computing other units. One pound portions of numerous home prepared foods have been included to facilitate computations for certain types of dietary studies.

The weights of common household units of food and their approximate measures shown in this table were taken from several sources, published and unpublished or were calculated from the density of the food. The weights thus obtained in many instances do not represent a high degree of accuracy for the volume or measure but the nutrient values in the table are for the weight specified. Weights per volume or count reported by different laboratories or individuals varied widely in many cases and the approximate measure and the food itself were not always adequately described in the report. To minimize the errors in interpreting the units of measure and weight, descriptions have been made as specific and adequate as possible.

## Sources of Data

The data appearing in this table has been compiled over a period of years from published and unpublished literature and except in a few cases, are averages of original analytical data. It is not practicable to list the numerous sources in detail.

Research at colleges, universities and Agricultural Experiment Stations, as well as research by scientific organizations and by industry, have contributed the major portion of the data used for deriving the averages. As new data on any food item became available in the literature or from unpublished sources, they were added to the array on file, if suitable, and a new average derived. For some foods, chiefly in the case of the mineral content, data were taken from other compilations, especially published



summaries of Henry C Sherman. In other instances data are the result of investigations in a single laboratory. For example, figures on the proximate composition of cooked fish were supplied by courtesy of the Bureau of Fisheries, U S Department of Interior, from unpublished work in their laboratories.

A brief outline gives the user tables of food in 1896, and re-composition and energy value of an extensive list of foods. The tables contained minimum, maximum, and average values for water, protein, fat, carbohydrate, ash content, and energy value of the edible portion of the food and for refuse as well. The data were compiled by W O Atwater and his associates and were based in large measure on their own work and that of their colleagues, most of whom were working in Agricultural Experiment Stations and on a few experiments from foreign laboratories.

Since that time, compilation of data from original sources has been continued by the Department of Agriculture, and, at intervals, publications have been issued covering various phases of work on the composition of foods. A complete revision of the original tables was made by Charlotte Chatfield and Georgian Adams and published in 1940. The composition figures were brought up to date, taking into account changes in processing of foods and the introduction of new fruits and vegetables and new varieties.

As mineral and vitamin values of foods appeared in the literature or otherwise became available they also were added to the food composition files. When an urgent need arose early in World War II for a single food table showing not only calories and proximate composition but mineral and vitamin values as well, compilations of data were supplied by the Department and others to the Committee on Food Composition of the National Research Council's Food and Nutrition Board and used by them in a preliminary processed table. The table was revised and expanded as unpublished analyses were assembled by the efforts of that Committee and new research results became available. A printed edition, *Tables of Food Composition in Terms of Eleven Nutrients*, Miscellaneous Publication No 572 containing data on 275 foods was published in 1945 by the U S Department of Agriculture in cooperation with the National Research Council.

The present publication takes into account much new material. Figures have been revised as needed, and there have been added numerous foods not listed in the 1945 table as well as different forms of food, especially frozen and cooked foods.

### Notes About Food Items

In preparing this table an effort has been made to derive values typical of the product available the year around throughout the country. At present, however, it is impossible to prepare average composition values that are uniformly representative for all foods or even for all constituents of any one food. Some foods have been analyzed repeatedly for their content of a few nutrients and scarcely at all for other nutrients.

Cooked foods, a few prepared dishes, and frozen foods have been included in the table for the first time. Figures for these items are preliminary, in many cases based on very little experimental work. However, even in tentative form they more closely approximate the nutrient content of food as eaten than do data on uncooked foods. So far as possible the data presented were based on summaries of reported analyses, where necessary, however values were imputed either from another form of the same food or from a similar food. For example, in only a few cases were suitable analyses available on which to base figures for either the proximate or mineral composition of frozen foods or cooked vegetables. Where actual

data were lacking or appeared to be inconsistent, the composition of the drained portion of the canned food or of the raw product was used.

For cooked vegetables, vitamin values are based on studies in which fair to good cooking procedures were followed. Unless otherwise indicated, the values shown may be applied to vegetables cooked not too long in a moderate amount of water. Amount of water and length of time required to bring water back to boiling are two of the more important factors in vitamin retention. Small amounts of water and short heat up periods would result in higher vitamin content than shown in this table. Conversely, if the vegetable was started in a large amount of cold water, the values would be lower because of increased solution and destruction. Reheated left over vegetables would have much less thiamine and ascorbic acid than shown by the figures in the table.

**Enriched Flour**—The minimum levels for the required nutrients covered by the Federal enrichment legislation for flour have been entered in this table. These minimum levels are thiamine 20 mg, riboflavin 12 mg, niacin 16 mg, and iron 13 mg per pound. In addition to the amounts of iron and the three vitamins specified, certain levels of vitamin D and calcium were permitted as optional ingredients. Vitamin D is not included in this table, and except for self rising flours it has been assumed that manufacturers ordinarily do not add calcium.

**Self rising Flour**, as usually prepared, contains dicalcium phosphate, although sometimes a sodium salt is used. Self rising flour containing the calcium salt is estimated to have approximately 1,235 mg of calcium per pound and this figure appears in the table. The minimum amount required for enrichment is only 500 mg per pound and hence both the enriched and the unenriched self rising flours, as customarily prepared, have more calcium than the minimum level.

**Bread and Rolls**—The nutritive values shown for breads and rolls are the result of calculations made from formulas considered typical of present day commercial baking practices. Breads with 2% increments of nonfat milk solids up to the 6% level (flour basis, that is, 6 pounds nonfat milk powder per 100 pounds flour) have been entered because this range is believed to cover most of the white breads sold. For calculating nutritive values of diets when the level of milk solids in commercial bread is unknown, the bread having milk solids at the 4% level (flour basis) is suggested because present information indicates that the average amount of milk used is between 3 and 4% (flour basis). Bread made with 4 pounds of milk solids to 100 pounds of flour contains approximately 2½% of milk solids after baking. There is wide variation in the amount of milk used in bread. Instances are known in which bakers use as much as three and four times the average. A significant portion of the calcium content of breads shown in this table is from the mold inhibitor. In calculating the values for commercial white bread, it was assumed that 0.2 pound of calcium propionate was used to 100 pounds of flour. In the 4% milk bread, the calcium propionate would account for about 110 mg of the calcium in a pound of bread.

Enriched bread may be made either with enriched flour or with unenriched flour plus such other ingredients that 1 pound of the finished product will have not less than the minimum nor more than the maximum levels of certain nutrients as specified in the proposed Federal standards. The amounts of the nutrients specified appeared in the Federal Register for August 3, 1943, as follows:

	Minimum mg /lb	Maximum mg /lb
Iron	80	125
Thiamine	11	18
Riboflavin	07	16
Niacin	100	150

The minimum levels of iron, thiamine, riboflavin, and niacin in the proposed specifications for enriched bread have been entered in this table. In calculating the nutrients, it has been assumed that the breads were made with unenriched flour and that the amounts of the nutrients needed to meet the minimum levels specified for enrichment in addition to the amounts contributed by the ingredients of the formula would be supplied by adjusted enrichment preparations. However, if enriched flour was used along with significant quantities of nonfat milk solids, the level of these nutrients, riboflavin especially, would be higher. The effect of increasing milk solids by 2% increments may be observed by comparing the nutrient content of the unenriched breads having nonfat milk solids at the different levels specified.

Breakfast food cereals on the market tend more and more to have added nutrients. Nutritive values approximating some of these products have been included in the table. The nutrients usually added to these breakfast foods include one or more of the following: iron, thiamine, riboflavin, and niacin. Except for enriched farina and enriched grits, there are at present no Federal standards regarding the addition of nutrients, either as to the nutrient that may be added or its level in the finished product. The values for the breakfast foods with added nutrients shown in this table are averages of the composition data reported for commercial products that have the same generic classification and have approximately the same levels of added nutrients. Before using these data in any particular calculation, as in dietary studies, it would be well to check the data with the information given on the packages of several kinds in the current market to see whether values in this table are applicable.

Meat of medium fatness for each kind of animal makes up the main portion of meat consumed in this country and was therefore used as the basis for most of the data entered in the present table.

Composition data for meat of other degrees of fatness are entered for the carcass or side as a whole. In addition, under pork, the item "miscellaneous lean cuts" has been included for use when a figure is needed to represent the total of the so-called lean cuts of a medium fat carcass that go into ordinary retail channels. Excluded are the lard, bacon, salt side, and fat back.

Reliable average values on the proximate composition of wholesale cuts have been available for several years and have been used quite generally in dietary calculations for estimating the nutritive values of meat. When wholesale cuts of medium fatness are trimmed, fat along with some bone and a very little lean is often removed. The extent of the trimming is highly variable, and the composition of trimmed cuts cannot be estimated as accurately as that of wholesale cuts. For evaluating diets, the use of composition data on wholesale cuts, particularly in the case of beef, introduces considerable overestimation of fat and calories and a small underestimation of protein. The data for some of the fresh beef cuts shown in this table have been adjusted to allow for a moderate amount of trimming. Data for all other fresh meat cuts, including lamb, pork and veal, are from wholesale cuts considered most suitable.

Data for cooked meats were estimated from studies relating to changes in the composition of meat during cooking. Among the most important factors influencing these changes are temperature of cooking and degree of doneness. In so far as possible, data used to derive values for cooked meat in this table were from experiments in which the meat had been cooked to medium doneness at moderate temperatures by common methods suitable for the particular cut. Meat shrinks when cooked losing water, fat, some mineral matter and a little protein. The total loss in weight appears to be around 20 to 30% for meat with bone and about 30 to 40%

for meat without bone. Meat roasted at a very low temperature would be expected to shrink less than at higher temperatures. Reheating of left over meat would reduce considerably the thiamine values shown in this table.

### Notes on Nutrients and Other Components

Refuse figures refer to the percentage of the total purchased weight that the homemaker usually discards in preparing food for the family table. Refuse includes bones, pits, shells, and other inedible material. For some foods it includes portions that could be eaten but as a rule are discarded; for example, potato parings and tough outer leaves of vegetables. In general, data on refuse have been based on products in good condition and would not be suitable to apply to produce with excessive bruising, insect infestation or rot, nor would they apply if peeling and trimming are done extravagantly. In other words, data shown here for refuse do not include waste. The figures are considered suitable for use with food supplies purchased at retail but generally are not satisfactory for use with fresh produce bought at wholesale.

**Proximate composition** of food is the term which has come to be applied to the proportion of water, fat, carbohydrate, protein, and ash present in the food. Each component is made up of substances having some properties in common, but may include smaller amounts of substances that are unrelated chemically. This proximate grouping of long standing is convenient and is useful for many calculations.

**Protein** values have been calculated from nitrogen content, nearly always total nitrogen, by applying suitable conversion factors such as those published by Jones.<sup>1</sup> Counted with the true protein are other nitrogenous compounds such as amino acids and the purine bases. In cases where the nonprotein nitrogen exclusive of amino acid nitrogen, is fairly large, the figures for the protein content of the food have been adjusted to more nearly represent the sum of the true protein and amino acids present.

**Fat** refers, in the main, to ether-extractable materials including, in addition to the glycerol esters of fatty acids or true fats, various fatty acids, sterols, chlorophyll and other pigments or substances of similar solubility.

**Carbohydrate**, frequently referred to as "total carbohydrate by difference" is the term that has come to be used in this country to apply to the balance of the food components and is the difference between 100% and the sum of the percentages of protein, fat, ash, and water. In addition to the sugars and starches which the body uses almost completely, it includes other forms of carbohydrate which the body utilizes to a lesser degree if at all, such as fiber and pentosans. Included also are other substances that are not carbohydrate such as organic acids.

**Food Energy**—calories are the units used for expressing food energy. In this publication calories have been calculated by a modification of the procedure that has been in use in this country for 50 years. Instead of applying the general calorie factors 4, 9, 4 to the percentage composition of protein, fat, and carbohydrate respectively as has usually been done heretofore, more specific factors have been developed for individual foods or food groups. These more specific factors have been developed along the lines of Atwater's plan but take into consideration the more recent literature on digestibility and physiological energy value of foods.

The principle for this revised procedure of estimating the calorie values was published<sup>2</sup> in the report of the Committee on Calorie Conversion Factors and Food Composition Tables, convened by the Nutrition Division of

<sup>1</sup>Jones, D. B. Factors for Converting Percentages of Nitrogen in Foods and Feeds into Percentages of Protein. U. S. Dept. Agric. Cir. 183. 22 pp. 1941. (St. rev. ed.)

<sup>2</sup>Food and Agriculture Organization Nutrition Division. Energy yielding Components of Food and Computation of Calorie Values. 33 pp. 1947.

the Food and Agriculture Organization. Details of applying this procedure in the estimation of the calorie values of wheat flours of different extractions have also been published.<sup>3</sup> Factors not shown in either of these publications for calculating the calories from protein, fat, and carbohydrate in foods were based on an unpublished compilation of data in the files of the Bureau of Human Nutrition and Home Economics.

Calcium, phosphorus, and iron data shown in this table represent the total amounts of these elements present unless otherwise noted. The question of how to treat the calcium content of foods containing relatively large amounts of oxalic acid remains debatable. In this table the total calcium content is given but attention is called in a footnote to the possibility that all of it may not be available because of the presence of the oxalic acid. Likewise, deductions were not made for phytin present in the food.

Vitamin values in the literature for any one vitamin have been determined by a number of methods. In some cases the early exploratory procedures have been replaced by methods now thought to be highly reliable but the more reliable methods have not yet been applied to all foods. The application of better methods will call for a revision in some of the figures.

Vitamin A values in this table are expressed in International Units. They have been based, in part, on biological assay and, in part, on physical or chemical determinations of vitamin A itself or on one of its precursors. The physiological equivalence of vitamin A and of the carotenes having vitamin A activity has posed difficult questions. Scientists around the globe are not entirely in agreement as to how much carotene is equivalent to an International Unit of vitamin A. For this table, values expressed as micrograms of carotene were converted to IU of vitamin A on the basis that 0.6 microgram of beta carotene and 1.2 micrograms of other carotenes having vitamin A activity were equivalent to 1 IU of vitamin A. The problem of deriving suitable values for practical use in evaluating human diets is still further complicated by differences in availability of carotene from different sources. Experimental work with laboratory animals and human subjects have shown that the carotene in some foods is nearly all available and in others only one third or less is available. Future revisions of vitamin tables probably will require considerable change in vitamin A figures.

**B Vitamins**—Methods of extraction and assay for the three B vitamins (thiamine, riboflavin, niacin) included in the table are still in the process of development. Modifications of the preferred methods are resulting in greater sensitivity and precision and consequently in better agreement between methods. Results of applying the improved procedures have not as yet been reported for a great many foods, consequently many of the values are based on older methods. There is still considerable doubt concerning the adequacy of present methods for the release of the bound forms of riboflavin; anomalous values are occasionally reported for the retention of this vitamin in foods that have been subjected to heat. Niacin values were derived from data in the literature measuring nicotinic acid, nicotinamide and related active compounds.

Ascorbic acid values reported here have been based for the most part on determinations of reduced ascorbic acid because this was the form reported by most workers and is the form in which nearly all of this vitamin occurs in fresh products. Foods that have undergone storage or processing, however, have been found to contain significant quantities of the oxidized form (dehydroascorbic acid). Data on total ascorbic acid were used when authors reported data on both the reduced and the dehydro forms. Since data for estimating total ascorbic acid were far less often reported there may be some underestimation of the vitamin C value of the foods. On the other

<sup>3</sup>Merrill A. L. and Watt H. K. Physiologic Energy Values of Wheat  
J. Am. Dietet. A. 24: 953-956, 1948.

hand recent developments in methods for measuring the vitamin C value of products show that some foods contain interfering substances which react chemically like the vitamin but do not have the same physiological activity. These interfering substances are found especially in foods having a high carbohydrate content that have been subjected to heat or unfavorable storage conditions. Continued research on methods and application of the improved procedures are needed to show to what extent present data need revision.

### Signs and Symbols Used

An asterisk indicates an item for which the composition has been calculated from a recipe.

Parentheses denote imputed values for which little or no experimental evidence was available, for which there was relatively little basis for imputing a value from another form of the food, or for which reported data were not considered suitable. A zero in parentheses is used where actual data were lacking and the amount of a constituent present was regarded as none or probably too little to measure.

Dashes show that no basis could be found for imputing a value although there was some reason to believe that a measurable amount of the constituent might be present.

The word "Trace" is used to indicate vitamin values that would round to zero with the number of decimal places carried in these tables. For other components that would round to zero a zero is used. A zero followed by a decimal point indicates that there may be up to 0.5 of the unit present but bases for showing the amount were inadequate. Numbers with or without decimal points indicate that the average has been rounded to the nearest whole number, or in the case of vitamin A to the nearest multiple of ten.

FOOD EN FRGY CAL	PRO TFIN GM	FAT GM	TOTAL CARBO HY DRATE GM	CAL CIUM MG	PHOS PHO RUS MG	IRON MG	VITA MIN A VALUE IU	THIA MINE MG	RIBO FLAVIN MC	NIACIN MG	ASCOR BIC ACID MG
1 Almonds, dried, unblanched											
a Shelled, 1 cup (142 gm) ---	26.4	76.8	27.8	361	674	6.2	0	35	95	6.5	Trace
b In shell, 1 cup (78 gm) ---	7.4	21.6	7.8	102	190	1.8	0	.10	27	1.8	Trace
2 Apples											
a Raw, A.P. refuse, 12% 1 large (3 in diam, 230 gm)	6	8	30.1	12	20	6	180	08	06	4	9
b 1 medium (2½ in diam, 150 gm)	4	5	19.7	8	13	4	120	05	04	2	6
c 1 small 2¼ in diam, 114 gm)	3	4	14.9	6	10	3	90	04	03	2	5
d Raw, E.P. 1 cup cubed or sliced (142 gm)	4	6	21.2	9	14	4	130	06	04	3	7
3 Canned See Applesauce Dehydrated (small pieces), 1 pound	8.2	10.9	41.1	109	277	3.2	(0)	33	47	5.4	53
Dried											
4 Uncooked, 1 cup (114 gm) ---	16	11	83.4	22	55	1.6	(0)	11	11	1.1	14
5 *Cooked, unsweetened											
a 1 pound	18	14	94.4	23	64	1.8	(0)	09	14	1.4	9
b 1 cup (255 gm) ---	10	8	53.0	13	36	1.0	(0)	05	08	8	5
6 *Cooked, sweetened											
a 1 pound	18	14	124.8	23	54	1.8	(0)	09	09	9	9
b 1 cup (280 gm) ---	11	8	77.0	14	34	1.1	(0)	06	06	6	6
7 Apples and apricots, canned, strained (infant food), 1 ounce---	1	1	4.7	3	5	3	300	01	01	1	1
8 *Apple Betty											
a 1 pound	77	13.2	138.9	88	114	8	730	26	18	2.2	5
b 1 cup (230 gm) ---	39	6.7	70.4	34	58	2	370	13	09	1.1	3
9 Apple butter											
a 1 cup (282 gm) ---	11	2.3	128.0	30	59	1.7	(0)	03	06	4	5
b 1 tablespoon (18 gm) ---	1	1	8.2	3	4	1	(0)	Trace	Trace	Trace	Trace

	124	2	(0)	744	15	25	12	00	05	07	Tree	■
10 Apple juice, fresh or canned, 1 cup (249 gm) -----												
Applesauce, canned												
11 Unsweetened, 1 cup (239 gm) -----	100	5	5	261	10	19	19	70	05	02	.1	3
12 Sweetened, 1 cup (254 gm) -----	194	5	5	500	10	20	10	90	05	.07	.1	3
13 Strained (infant food), 1 ounce -----	17	1	1	45	1	2	1	20	Tree	Tree	Tree	1
Apricots												
14 Raw, 3 apricots (114 gm), ref use, pits, 6% -----	54	11	1	139	17	25	5	2,000	03	05	9	7
Canned												
15 Water pack, 1 cup halves and liquid (244 gm) -----	77	12	2	199	24	37	7	3,300	04	05	9	10
16 Syrup pack												
a 1 cup halves and syrup (256 gm) -----	205	15	3	349	26	39	9	3,400	04	06	9	10
b 4 medium halves and 2 tablespoons syrup (122 gm) -----	97	7	1	261	12	19	4	1,650	02	07	1	5
17 Strained (infant food), 1 ounce -----	17	3	1	43	6	9	(3)	(450)	(01)	(01)	(1)	(1)
Dried, sulfured												
18 Uncooked												
a Large 1 cup (28 halves, 162 gm) -----	423	94	6	1094	139	193	79	12,040	02	25	53	20
b Small, 1 cup (40 halves, 150 gm) -----	393	79	6	1004	129	178	74	11,140	02	24	49	19
19 *Cooked, unsweetened, fruit and liquid												
a 1 pound -----	786	77	5	990	127	177	73	10,000	02	.23	45	14
b 1 cup (approx 25 halves, 285 gm) -----	242	49	3	621	90	111	46	6,000	01	14	29	9
20 *Cooked, sweetened, fruit and syrup												
a 1 pound -----	559	69	5	1435	109	154	64	9,580	01	19	41	14
b 1 cup (approx 25 halves, 325 gm) -----	400	49	3	1027	78	110	46	6,860	01	.13	29	10
21 Frozen, 3 ounces -----	70	6	1	179	9	14	3	1,410	02	03	4	3

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value



TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A IU	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
23 Asparagus Cooked	92	10.9	9	16.3	86	241	4.5	4,720	59	77	5.4	104
a 1 pound -----	36	4.2	4	6.3	33	93	1.8	1,820	23	30	2.1	40
b 1 cup cut spears (175 gm) -----												
24 Canned, green Solids and liquid	42	4.5	7	6.9	43	103	4.1	1,450	10	23	2.1	35
a 1 cup cut spears with liquid (239 gm) -----												
b 6 spears, medium size, with 2 tablespoons liquid, 126 gm) -----	22	2.4	4	3.7	23	54	2.1	760	09	12	1.1	19
25 Drained solids	97	10.9	18	15.4	86	241	8.6	3,630	30	37	4.4	80
a 1 pound -----	38	4.2	7	8.0	33	93	3.3	1,400	11	14	1.7	31
b 1 cup cut spears (175 gm) -----												
c 6 spears, medium size (96 gm) -----	21	2.3	4	3.3	18	51	1.8	770	06	08	9	17
26 Canned, bleached Solids and liquid	43	3.8	7	7.9	36	79	2.2	110	13	16	1.8	35
a 1 cup cut spears with liquid (239 gm) -----												
b 6 spears, medium size, with 2 tablespoons liquid (126 gm) -----	23	2.0	4	4.2	19	42	1.1	60	07	08	9	19
27 Drained solids	39	3.7	9	6.3	28	72	1.8	140	09	12	(15)	31
a 1 cup cut spears (175 gm) -----											(8)	17
b 6 spears, medium size (96 gm) -----	22	2.0	5	3.5	15	39	1.0	70	05	07		
29 Avocados, raw	372	2.6	40.1	7.8	15	58	9	420	10	20	1.7	24
a 1 cup (1/2 in cubes, 152 gm) -----												
b 1/2 peeled avocado, (3 1/2 by 3 1/2 in diam, 114 gm) -----	279	1.9	30.1	5.8	11	43	7	330	07	15	1.7	18





Beef cuts cooked													
Chucks													
64	a	1 pound with bone	1140	96	91	0	10	171	114	(0)	14	--	1-2
	b	1 pound without bone	1406	119	100	0	-0	71	141	(0)	22	93	18
	c	3 ounces with bone	1406	119	100	0	9	100	24	(0)	61	1-	75
Flank													
66	a	1 pound with bone	1381	110	101	0	18	215	132	(0)	1-	89	180
	b	1 pound without bone	1425	114	104	0	-0	211	131	(0)	2-	92	186
	c	3 ounces without bone	1425	114	104	0	9	200	26	(0)	65	17	35
Hind quarter													
68	a	1 pound	1404	100	136	0	41	177	12-	(0)	75	85	219
	b	3 ounces	1316	99	100	0	9	174	24	(0)	67	16	41
Lean See Round													
Porterhouse													
70	a	1 pound with bone	1409	86	100	0	41	132	112	(0)	24	18	173
	b	1 pound without bone	1554	104	125	0	-0	131	131	(0)	1	81	211
	c	3 ounces without bone	1554	104	125	0	1	145	21	(0)	69	15	40
Rib roast													
72	a	1 pound with bone	1400	99	100	0	33	112	11	(0)	21	60	142
	b	1 pound without bone	1449	109	109	0	43	116	14	(0)	24	82	145
	c	3 ounces without bone	1449	109	109	0	9	117	21	(0)	65	13	76
Round													
74	a	1 pound with bone	1407	107	11	0	43	113	134	(0)	70	80	219
	b	1 pound without bone	1407	107	11	0	50	107	154	(0)	71	99	211
	c	3 ounces without bone	1407	107	11	0	9	191	21	(0)	66	19	47
Rump													
76	a	1 pound with bone	1371	97	99	0	23	263	2-	(0)	15	48	96
	b	1 pound without bone	1371	97	99	0	36	266	114	(0)	19	70	141
	c	3 ounces without bone	1371	97	99	0	7	22	21	(0)	64	33	26
Sirloin													
78	a	1 pound with bone	1173	91	87	0	40	691	115	(0)	26	74	188
	b	1 pound without bone	1346	104	100	0	45	794	132	(0)	70	85	217
	c	3 ounces without bone	1346	104	100	0	9	149	23	(0)	66	16	41
Beef cannon													
80	a	Corned beef hash 3 ounces	120	117	52	61	92	124	11	Trace	02	11	24
	b	Roast beef 3 ounces	189	21	11	0	14	99	20	(0)	02	19	36
91	a	Strained (infant food) 1 ounce	30	49	10	0	3	43	12	(0)	Trace	06	9

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

DATA assume cut to be prepared by braising or pot roasting. Use of proportionate quantity of drippings would all approx-  
imately 50% more thiamine and niacin and 25% more riboflavin.

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD EN- ERGY CAL	PRO- TEIN GM	FAT GM	TOTAL CARBO- HY- DRATE GM	CAL- CIUM MG	PHOS- PHO- RUS MG	IRON MG	VITA- MIN A VALUE IU	THIA- MINE MG	RIBO- FLAVIN MG	NICOTIN- IC MG	ASCOR- BIC ACID MG
Beef, corned, canned												
83 Lean, 3 ounces	159	22.5	7	0	18	94	3.8	(0)	.01	.21	.30	0
84 Medium fat, 3 ounces	182	21.5	10	0	17	90	3.7	(0)	.01	.20	.29	0
85 Fat, 3 ounces	221	20.0	15	0	16	83	3.4	(0)	.01	.19	.27	0
86 Beef, dried and chopped												
a 1 cup (165 gm)	336	55.6	10.4	0	33	667	8.4	(0)	(.12)	(.53)	(.63)	0
b 2 ounces	115	19.4	3.6	0	11	229	2.9	(0)	(.04)	(.18)	(.22)	0
87 *Beef and vegetable stew												
a 1 pound	487	25.0	37.2	32.2	59	340	5.0	4,870	.24	.29	.66	28
b 1 cup (235 gm)	252	12.9	19.3	16.7	31	176	2.6	2,590	.12	.15	.34	15
88 Beer (average 4% alcohol), 1 cup (240 gm)		1.4	0	10.6	10	62	0	(0)	Trace	.06	.4	(0)
Beets, common red												
89 Raw, peeled root, 1 cup diced (134 gm)	56	2.1	1	12.9	36	58	1.3	30	.03	.06	.6	13
90 Cooked												
a 1 pound	187	4.5	5	44.5	95	141	3.2	90	.09	.18	.14	30
b 1 cup diced (165 gm)	68	1.6	2	16.2	35	51	1.2	30	.03	.07	.5	11
91 Canned, solids and liquid, 1 cup (246 gm)	82	2.2	2	19.4	37	71	1.5	40	.02	.06	.3	12
92 Drained solids												
a 1 pound	187	4.5	5	44.5	95	141	3.2	80	.05	.13	.5	21
b 1 cup diced (165 gm)	68	1.6	2	16.2	35	51	1.2	30	.02	.05	.2	8
93 Strained (infant food), 1 ounce	10	.4	0	2.2	5	7	.2	Trace	Trace	.01	Trace	.2
95 Beet greens, common, cooked												
a 1 pound	125	9.1	1.4	25.4	1,536	204	14.5	33,780	.23	.73	1.8	68
b 1 cup (145 gm)	39	2.9	.4	8.1	2,171	65	4.6	10,790	.07	.23	.6	22
96 Beverages, carbonated												
Ginger ale, 8 fluid ounces (1 cup, 230 gm)	80			31								





Item	Iron	Thiamine	Riboflavin	Niacin	Calcium	Phosphorus	Protein	Energy	Iron	Thiamine	Riboflavin	Niacin	Calcium	Phosphorus	Protein	Energy	Iron	Thiamine	Riboflavin	Niacin	Calcium	Phosphorus	Protein	Energy
1-7	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1-8	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
120	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
130	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
131	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
132	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
133	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
134	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
135	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
136	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
137	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
138	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
139	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
140	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
141	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
142	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
143	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
144	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
145	110	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value of iron, thiamine, riboflavin, and niacin are based on the minimum level of enrichment specified in the standards of the Federal Security Agency and published in the Federal Register, August 3, 1943. When the amount of nonfat milk solids in commercial bread is unknown, use bread with 4% nonfat milk solids. Item 135 for enriched bread and 139 for enriched.



TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GV	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
Breakfast foods, mixed cereals—Cont'd												
146 Wheat and malted barley, ready to eat (added thiamine and niacin), 1 cup (105 gm) ---	379	11.6	6	86.9	49	346	3.7	(0)	50	18	4.9	(0)
Breakfast foods See individual grain, ■ Corn, Oatmeal, etc												
Broccoli												
148 Cooked, flower stalks	133	15.0	9	25.0	590	345	5.9	15,440	32	68	3.6	336
a 1 pound ---	44	5.0	3	8.2	195	114	2.0	5,100	10	22	1.2	111
b 1 cup (150 gm) ---												
Brown Betty See Apple Betty												
151 Brussels sprouts, cooked	212	20.0	2.3	40.4	154	354	5.9	1,320	18	54	2.3	213
a 1 pound ---	60	5.7	6	11.6	44	101	1.7	520	0.5	16	6	61
b 1 cup (130 gm) ---												
Buckwheat flour												
153 Dark, 1 cup sifted (98 gm) ---	326	11.5	2.4	70.6	32	340	2.7	(0)	56	15	2.8	(0)
154 Light, 1 cup sifted (98 gm) ---	340	6.3	1.2	77.9	11	86	1.0	(0)	0.8	(0.4)	(4)	(0)
Buckwheat pancake mix See Pancake mix												
Butter												
155 1 cup (224 gm) ---	1,604	13	181.4	9	45	36	0	17,390	--	--	--	--
a 1 tablespoon (14 gm) ---	100	1	11.3	1	3	2	0	1,460	--	--	--	--
c 1 pat or square (64 per lb, 7 gm each) ---	50	0	5.7	0	1	1	0	1,230	--	--	--	--
Buttermilk, cultured (made from skim milk)												
156 1 quart (976 gm) ---	348	34.2	1.0	49.8	(1,152)	908	7	40	35	43	1.1	13
b 1 cup (244 gm) ---	86	8.5	■	12.4	(289)	227	2	10	0.9	1.74	■	3

		109	64	9	241	209	141	23	3-0	27	24	14	208
157	Cabbage Raw, F P												
a	1 round, trimmed	109	64	9	241	209	141	23	3-0	27	24	14	208
b	1 wedge (3 1/2 by 4 1/2 in, 100 gm)	24	14	2	53	16	31	3	80	66	05	3	70
c	1 cup shredded finely (100 gm)	24	14	2	53	16	31	3	80	66	05	3	70
158	Cooked (small amount of water short time)												
a	1 pound	109	64	9	241	209	141	23	410	33	23	14	111
b	1 cup (170 gm)	10	24	3	90	79	33	8	150	08	08	3	53
159	Cooked (large amount of water long time)												
a	1 pound	109	64	9	241	209	141	23	410	14	14	9	56
b	1 cup (170 gm)	40	24	3	90	79	33	8	150	03	03	3	72
	Cabbage, See Colelaw												
161	Cabbage, celery or Chinese Raw 1 cup leaves and stems (1 in pieces 100 gm)	34	12	3	24	43	11	9	290	03	04	1	31
162	Cooked												
a	1 pound	64	34	14	109	19	180	11	1180	09	14	14	100
b	1 cup (190 gm)	22	23	6	46	82	79	17	100	04	06	6	12
	*Cakes												
163	Angel food 2 inch sector (1 1/2 of 8 in diam 40 gm)	109	34	1	233	2	10	1	0	Trace	03	1	(0)
164	Foundation 1 square (3 by 2 by 1 1/4 in 65 gm)	209	38	6	363	92	78	3	100	02	03	2	(0)
165	Foundation plain icing 3 inch sector of layer cake (1/4 of 6 in diam 90 gm)												
a	2 inch sector of layer cake (1/4 of 10 in diam 120 gm)	308	45	84	544	91	86	4	110	02	06	2	(0)
b													
		410	60	112	725	121	115	5	150	03	08	2	(0)

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value; Year round average.

161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

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Item	Description	Nutrient Content									
		Cal	Protein	Carb	Fat	Vit A	Vit B	Vit C	Calc	Iron	Other
173	Sponge 2 inch sector (1/2 of 8 in diam 40 gm)	117	3.2	2.0	21.9	11	44	99	94	3	170
174	Citron, 1 ounce	89	1	1	22	24	7	1	1	1	1
175	Ginger root crystallized 1 ounce	90	1	1	21	24	7	1	1	1	1
176	Lemon, orange or grapefruit peel 1 ounce	90	1	1	22	24	7	1	1	1	1
177	Butterscotch 1 ounce	116	0	2	21	6	2	6	2	2	2
178	Caramel 1 ounce	118	0	3	22	7	2	6	2	2	2
179	Chocolate sweetened milk 1 ounce	143	2	0	1	41	80	3	10	0	0
180	Chocolate sweetened milk with almonds 1 ounce	151	2	10	14	34	7	6	10	0	0
181	Chocolate cream 1 ounce	110	1	4	0	0	0	0	0	0	0
182	Fondant 1 ounce	101	0	0	0	0	0	0	0	0	0
183	Fudge plain 1 ounce	116	0	3	2	14	19	1	0	0	0
184	Hard 1 ounce	108	0	0	2	0	0	0	0	0	0
185	Marshmallows 1 ounce	92	0	0	2	0	0	0	0	0	0
186	Peanut brittle 1 ounce	125	2	4	20	11	25	6	10	0	0

Note: Asterisk indicates that values are calculated from a recipe; parentheses in brackets indicate imputed values.

If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 350 IU per square item 174 350 IU per 3 inch sector item 165a and 166a and 5.9 IU per inch sector item 165b and 166b.

If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 120 IU.

If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 200 IU per large square, item 168a 150 IU per cupcake item 168b 90 IU per small cupcake or square item 168c 210 IU per 3 inch sector item 169a 140 IU per cupcake item 169c and 110 IU per small cupcake or square item 169d.

If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 300 IU.

If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 600 IU per square item 171 item 172a and 900 IU per 2 inch sector item 172b.

If the calcium contributed by chocolate is considered unavailable the value would be 11 mg per ounce.

## COMPOSITION OF FOODS

TABLE 138—CONT 2

FOOD DESCRIPTION AND APPROXIMATE MEASURE	FOOD EN- ERGY CAL	PRO- TEIN GM	PAT- ERN GM	TOTAL CARBO- HY- DRATE GM	CAL- CIUM MG	PHOS- PHO- RUS MG	IRON MG	VITA- MIN A VALUE IU	THIA- MINE MG	RIBO- FLAVIN MG	NIACIN MG	ASCOR- BIG ACID MG
187 Cantaloups raw												
a ½ melon (5 in diam 385 gm)	37	11	4	83	31	29	7	16	09	07	9	59
b 1 cup diced (145 gm)	30	9	3	67	25	23	6	14	07	05	7	47
188 Carrots												
a Raw												
1 carrot (5½ by 1 in or 25 thin strips 50 gm)	21	6	2	46	90	18	4	6	03	03	3	3
b 1 cup grated (110 gm)	40	13	2	100	43	41	9	13	06	06	7	7
189 Cooked 1 cup diced (145 gm)	44	9	7	93	38	38	9	18	07	07	7	8
190 Canned												
Solids and liquid 1 cup diced (245 gm)	69	12	10	150	54	59	15	29	06	05	8	6
191 Drained solids												
a 1 pound	138	27	23	291	118	118	27	79	10	10	14	12
b 1 cup diced (145 gm)	44	9	7	93	38	38	9	25	03	03	4	4
192 Strained (infant food) 1 ounce	7	3	0	17	7	7	2	2	01	01	1	1
194 Cashew nuts roasted or cooked 1 ounce	164	52	137	77	13	191	14		18	05	6	
Catsup tomato See Tomato cat sup												
195 Cauliflower												
a Raw 1 cup flower buds (100 gm)	25	94	2	49	93	72	11	90	11	10	6	69
196 Cooked												
a 1 pound	113	109	9	292	100	397	50	410	97	36	23	127
b 1 cup (100 gm)	30	99	9	59	96	86	13	108	07	10	6	34





Food	Protein	Carbohydrate	Fat	Calories	Water	Fiber	Minerals	Vitamins	Other
224 Raw, 1 cup (210 gm)	13.7	9.9	1.7	193	11.9	Trace	1.16	7.2	(4)
225 Chile con carne (without beans) canned, 1 1/4 cup (81 gm)	1.0	9.8	1.2	72	1.2	1.79	0.1	1.1	-
226 Chili sauce a 1 cup (273 gm) b 1 tablespoon (17 gm)	0.8 1.7	11 1	0.17 0.0	(33) (2)	(1.9) (.3)	(5.170) (7.0)	(.25) (.02)	(.61) (.1)	(11) (2)
227 Chocolate a Bitter or unsweetened b 1 ounce 1 cup grated (132 gm) Sweetened Plain 1 ounce Milk See Can Milk with almonds See Can	14.7 16.7 17.7	15.0 19.8 8.4	4.4 4.4 1.2	228 270 118	1.2 1.8 8	0 80 (10)	0.1 0.6 (.01)	7 1.3 (.2)	(0) (0) (0)
229 *Chocolate beverage made with milk 1 cup (250 gm)	1.0	9.2	1.1	26.2	1.1	1.0	0.8	7	2
230 Chocolate syrup 1 tablespoon (20 gm)	4.2	2.2	1.1	17	(17)	1.1	-	-	-
Cider See Apple juice Citron See Candy									
231 Clams long and round a Raw meat only 4 ounces b Canned solids and liquid 3 ounces	9 44	14.5 6.1	1.6 0	39 1.9	(109) 4	(1.8) (.70)	11 (.01)	(1.9) 9	-- 9

Note: Asterisk indicates that values are calculated from a recipe. Parentheses indicate imputed value.

153 mg if the added emulsifying agent does not contain phosphorus.

Vitamin values based on muscle meat only.

\*Not less than 60% meat not more than 8% cereals seasoning.

†Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar.

‡Calcium may not be available because of presence of oxalic acid.

The remaining por





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Note Asterisk indicates that values are calculated from a recipe. Parentheses indicate imputed value.  
 \*Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar.  
 †portion is made up of materials thought to be utilized only poorly if at all by the body.  
 ‡Calcium may not be available because of presence of oxalic acid.  
 §Vitamin A based on yellow corn white corn contains only a trace.  
 ¶Based on recipe using white corn meal if yellow corn meal is used vitamin A value is 160 IU.  
 †Based on recipe using yellow corn meal if yellow corn meal is used vitamin A value is 190 IU.



No.	Description	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
268	Corn and soy grits <i>See Breakfast foods mixed cereals</i>	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	fast foods mixed cereals	151	11.4	1.0	25.4	9.0	9.0	1.0	1.0	1.0	1.0	1.0	7.2
269	Cornstarch <i>See Starch</i>	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	Cornstarch pudding <i>See Blanc mange</i>	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
270	Cottonseed oil <i>See Oils solid or cooking</i>	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	Cowpeas	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
b	Immature seed cooked	151	11.4	1.0	25.4	9.0	9.0	1.0	1.0	1.0	1.0	1.0	7.2
c	1 pound	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
d	1 cup (160 gm)	151	11.4	1.0	25.4	9.0	9.0	1.0	1.0	1.0	1.0	1.0	7.2
e	Mature seeds dry 1 cup (200 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
271	Cranberries Atlantic and Pacific bay shell	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
272	Canned or cooked meat only	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	3 ounces	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
273	Crackers	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	Graham 4 small or 2 medium (14 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
b	Saltines 2 crackers (2 in square 9 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
c	2 crackers (2 1/2 in square 11 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
d	1 cup oyster crackers 1 ounce	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
e	10 oyster crackers or 2 table spoon cracker meal (10 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
274	Cracker meal <i>See Crackers soda</i>	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
275	Cranberries raw 1 cup (113 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21
a	Cranberries raw 1 cup (113 gm)	429	129	27	222	168	9.6	11.4	1.70	1.32	35	7.6	21

Note: Asterisk indicates that values are calculated from a recipe; parentheses in brackets indicate imputed value.

Vitamin A based on yellow corn flour; white corn flour contains only a trace.

Vitamin A based on yellow corn grits; white corn grits contain only a trace.

Vitamin A based on yellow corn meal; white corn meal contains only a trace.

Vitamin A based on yellow corn meal; white corn meal contains only a trace.

## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD EN- ERGY	PRO- TEIN	FAT	TOTAL CARBO- HY- DRATE	CAL- CU- LUM	PHOS- PHO- RUS	IRON	VITA- MIN A I U	THIA- MINE	RIBO- FLAVIN	NIACIN	ASCOR- BIC ACID
		CAL	GM	GM	GM	MG	MG	MG		MG	MG	MG	MG
278	Cranberry sauce, sweetened, canned or cooked, 1 cup (277 gm)	549	3	8	142.4	(22)	(19)	(8)	(80)	(06)	(06)	(3)	5
279	Cream												
a	Light table, or coffee												
b	½ pint (240 gm)												
280	Heavy whipping	489	70	48.0	9.6	233	185	.1	1,980	07	34	.2	Trace
a	Heavy or whipping	30	4	3.0	6	15	12	.0	120	Trace	02	Trace	Trace
b	½ pint (approx 1 pt whipped, 236 gm)	779	54	82.6	7.6	184	144	1	3,390	06	26	.1	Trace
	1 tablespoon (15 gm)	49	3	5.2	5	12	9	0	220	Trace	02	Trace	Trace
281	Cress, garden												
a	Raw, 1 pound EP	186	191	6.4	24.1	953	(173)	(13.2)	13,470	49	.75	4.5	396
282	Boiled in small or moderate amount of water until tender												
a	1 pound												
b	1 cup (180 gm)	186	191	6.4	24.1	958	(173)	(13.2)	14,980	32	68	3.6	177
283	Boiled in large amount of water a long time	73	76	2.5	9.5	380	(68)	(5.2)	5,940	13	27	1.4	70
a	1 pound												
b	1 cup (180 gm)	186	191	6.4	24.1	958	(173)	(13.2)	14,980	.27	59	3.2	132
284	Cress, water, leaves and stems, raw, 1 pound	73	76	2.5	9.5	380	(68)	(5.2)	5,940	.11	23	1.3	52
285	Croaker, raw, 4 ounces EP	84	77	1.4	15.0	885	209	9.1	21,450	37	.71	3.6	350
286	Cucumbers, raw	109	20.2	2.5	0	--	--	--	--	18	07	2.0	--
a	1 cucumber (7½ by about 2 in, 290 gm)												
b	6 slices, peeled (¼ in thick center section, 50 gm)	25	14	2	5.5	20	43	6	0	07	09	4	17
	Cucumber pickles See Pickles	6	4	0	1.4	5	10	1	2	02	02		

Food	600	100	25	50	75	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	Trace	Trace	Trace
298 *Custard, baked	519	241	245	509	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519
a 1 pound	519	241	245	509	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519	519
b 1 cup (245 gm)	245	131	134	274	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283	283
Custard pie See Pie																											
299 Custard pudding, canned (strained infant food), 1 ounce	71	9	9	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Dandelion greens																											
300 Raw, 1 pound 1 P	200	123	12	400	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419
301 Cooked																											
a 1 pound	200	123	12	400	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419	419
b 1 cup (160 gm)	79	49	13	138	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137	137
302 Dates "fresh" and dried 1 cup pitted, cut (179 gm)	305	39	11	1312	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128	128
303 Doughnuts cake type																											
a 1 dozen (13½ or 387 gm)	1626	253	804	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014	2014
b 1 doughnut (32 gm)	136	21	6	163	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
304 1 ele raw 4 ounces 1 P	143	211	103	0	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Eggs hen, fresh stored, or frozen																											
Raw																											
Whole																											
a 1 medium (54 gm), refuse shell	77	61	77	1	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
b 1 cup (5 med 243 gm)	204	311	279	17	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131	131
White																											
a 1 egg white (med 31 gm)	15	33	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
b 1 cup (8 med whites, 243 gm)	121	262	0	19	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Yolk																											
a 1 egg yolk (med, 17 gm)	61	29	54	1	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
b 1 cup (14 med yolks, 243 gm)	878	396	773	17	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357	357

Note: Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value. Based on pared cucumber unpured contains about 0.6 mg of iron and 130 IU vitamin A.

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALORIC MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE IU	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
Eggs, hen, fresh, stored, or frozen—Cont'd												
Cooked												
Hard cooked												
299 a 1 pound, refuse, shell, 11%	655	51.7	46.5	2.8	218	848	10.9	4,500	34	1.11	3	0
b 1 egg in shell, refuse, shell, 11% (54 gm)	77	6.1	5.5	3	26	101	1.3	550	0.4	13	Trace	0
300 *Omelet												
a 1 pound	775	49.9	58.1	10.0	363	881	9.5	4,720	35	1.22	2	0
b 1 egg omelet (62 gm)	106	6.8	7.9	1.4	50	120	1.3	640	0.5	17	Trace	0
301 Poached												
a 1 pound	729	57.7	51.8	2.7	245	953	12.4	5,150	36	1.09	3	0
b 1 egg (48 gm)	77	6.1	5.5	3	26	101	1.3	540	0.4	12	Trace	0
302 *Scrambled												
a 1 pound	775	49.9	58.1	10.0	363	881	9.5	4,720	35	1.22	2	0
b 1 egg (62 gm)	106	6.8	7.9	1.4	50	120	1.3	640	0.5	17	Trace	0
c 1 cup (220 gm)	376	24.2	28.2	4.8	178	427	4.6	2,390	17	59	1	0
*Dried												
a Whole, 1 cup (108 gm)	640	50.5	45.4	2.7	205	838	9.5	4,040	36	1.14	3	0
303 b White, 1 cup (56 gm)	223	48.1	0	3.5	27	76	9	0	0	1.15	4	0
305 c Yolk, 1 cup (96 gm)	666	30.0	58.9	1.2	271	1,078	13.2	5,320	48	64	1	0
306 Endive raw, 1 pound EP	90	7.3	9	18.2	359	254	7.7	13,600	30	53	18	49
Escarole, raw See Endive												
Evaporated milk See Milk, cow												
Farina												
Unenriched												
307 Raw, 1 cup (169 gm)	625	18.4	1.4	130.8	47	189	1.7	(0)	0.9	10	1.4	(0)
308 *Cooked												
a 1 pound	198	5.9	5	41.3	14	59	5	0	0.3	0.3	5	(0)
b 1 cup (238 gm)	104	3.1	3	21.7	7	31	2	0	0.1	0.2	2	(0)
Enriched												
309 Raw, 1 cup (169 gm)	625	18.4	1.4	130.8	47	189	1.7	(0)	0.62	1.45	1.22	(0)
310 *Cooked												
a 1 pound	198	5.9	5	41.3	14	59	5	0	0.18	1.4	7	(0)
b 1 cup (238 gm)	104	3.1	3	21.7	7	31	2	0	0.10	0.7	4	(0)

[illegible]

Note Asterisk indicates that values are calculated from a recipe purchases in illicite impute I value.

Iron, thiamine, riboflavin and niacin are based on the minimum levels of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act.



TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD EN FIBER CAL	PRO TEIN GM	FAT GM	TOTAL CARBO HY DRATE GM	CAL CHL MG	PHOS PHO RUS MG	IRON MG	VITA MIN A VALLE IU	THIA MINE MG	RIBO FLAVIN MG	NIACIN MG	ASCOR BIC ACID MG
*Gelatatin dessert, ready to serve													
331	Plain	296	7.3	0	69.0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
a	1 pound	155	3.8	0	36.3	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
332	With fruit added	324	6.4	5	79.4	27	50	1.4	510	13	0.9	1.0	13
a	1 pound	172	3.4	2	42.2	14	27	.7	270	0.7	0.5	.5	7
b	1 cup (241 gm)												
Ginger ale See Beverages, carbonated													
323	*Gingerbread, 1 piece (2 by 2 by 2 in, 55 gm)	180	2.1	6.6	28.4	63	39	1.4	50	0.2	0.5	6	(0)
Goat milk See Milk, goat													
324	Gooseberries, raw, 1 cup (150 gm)	59	1.2	3	14.6	33	42	8	440	--	--	--	40
Grapefruit													
325	Raw, refuse, rind and seeds, 34%												
a	1/2 large (5 in diam, No 46's, 395 gm)	104	1.3	5	26.4	57	47	5	20	10	0.5	5	105
b	1/2 medium (4 1/4 in diam, No 64's, 285 gm)	75	9	4	19.0	41	34	4	20	0.7	0.4	4	76
c	1/2 small (3 1/2 in diam, No 96's, 190 gm)	49	6	2	12.6	28	22	3	10	0.5	0.2	3	50
d	1 cup sections (194 gm)	77	10	4	19.6	43	35	4	20	0.7	0.4	4	78
326	Canned in syrup, solids and liquid, 1 cup (249 gm)	191	1.5	5	47.6	32	35	7	20	0.7	0.5	5	74
Grapefruit juice													
327	Fresh, 1 cup (246 gm)	87	1.2	2	22.6	33	32	.7	20	0.9	0.5	5	88
328	Canned, Unsweetened, 1 cup (246 gm)	92	1.2	2	24.1	33	32	7	20	0.7	0.4	4	85

	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
330 Grapefruit juice concentrate Frozen 1 can (6 fluid ounces 202 gm) -- -- --	111	111	111	111	111	111	111	111	111	111	111	111	111	111	111
331 Grapefruit orange juice blend Canned Unsweetened 1 cup (246 gm) 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
332 Sweetened 1 cup (273 gm) 13 13 13 13 13 13 13 13 13 13 13 13 13 13 13 13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
333 Frozen concentrate, 1 can (6 fluid ounces 202 gm) 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
334 Grapes raw American type (ship skin) as Concord Delaware Niagara and Scuppernon a 1 bunch (3 1/2 lb 3 in 100 gm) 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55 55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
b 1 cup with skins and seeds (153 gm) 84 84 84 84 84 84 84 84 84 84 84 84 84 84 84 84	84	84	84	84	84	84	84	84	84	84	84	84	84	84	84
335 European type (adherent skin) as Malaga Muscat Sultanina (Thompson Seedless) and Flame Tokay 1 cup (40 grapes 3/4 in diam 160 gm) 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
336 Grape juice bottled commercial 1 cup (254 gm) 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
337 Guava common raw refuse skins 1 guava (80 gm) 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49 49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
338 Griddlecakes See Pancakes															
339 Haddock Cooked fried a 1 pound 719 719 719 719 719 719 719 719 719 719 719 719 719 719 719	719	719	719	719	719	719	719	719	719	719	719	719	719	719	719
b 1 fillet (4 by 3 by 1/4 in 100 gm) 158 158 158 158 158 158 158 158 158 158 158 158 158 158 158	158	158	158	158	158	158	158	158	158	158	158	158	158	158	158

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD ENGL CAL	PRO TEIN GM	FAT GM	TOTAL CARBO HY DRATE GM	CAL CIUM MG	PHOS PHO RUS MG	IRON MG	VITA MIN A VITUP IU	THIA MINE MG	RIBO FLAVIN MG	NIACIN MG	ASCOR ACID MG
341	Habibut												
a	Cooked, broiled	827	1189	35.4	0	64	1,217	36	--	28	33	47.5	--
b	1 pound	228	328	9.8	0	18	335	10	--	08	09	13.1	--
	1 steak (4 by 3 by 1/2 in, 125 gm)												
	Ham, See Pork												
	Hamburger, See Beef												
	Heart												
342	Beef, lean, raw, 3 ounces	92	14.4	3.1	6	8	173	3.9	30	50	.75	66	5
343	Calf, canned, strained (infant food), 1 ounce	23	3.8	.7	1	3	43	1.0	--	02	.23	13	--
344	Chicken, raw, 3 ounces	134	17.4	6.0	14	20	121	1.4	30	10	.77	4.4	5
345	Pork, raw, 3 ounces	100	14.4	4.1	3	30	112	2.3	30	36	1.05	5.1	5
346	Herring, Atlantic, raw, 4 ounces												
347	EP	217	20.8	14.2	0	--	290	1.2	130	62	.17	39	--
348	Herring, lake, raw, 4 ounces EP	159	21.0	7.7	0	14	172	.6	110	10	.10	3.5	--
349	Herring, Pacific, raw, 4 ounces EP												
	Herring, smoked, kippered, 3 ounces EP	106	18.8	2.9	0	--	--	--	110	03	.25	(2.5)	--
	Komony, dry, See Corn grits	180	18.9	11.0	0	56	216	(1.2)	0	Trace	.24	(2.5)	--
350	Honey, strained or extracted.												
a	1 cup (338 gm)	992	1.0	0	268.7	17	54	3.0	(0)	02	.13	.7	12
b	1 tablespoon (21 gm)	62	.1	0	16.7	1	3	.2	(0)	Trace	.01	Trace	1
351	Honeydew melon, raw												
a	1 wedge (2 by 7 in, 150 gm, from melon, 6 1/2 by 7 in), without seeds, and rind	49	8	0	12.8	(26)	(24)	(6)	60	07	.04	3	34
352	*Ice cream, plain												
a	1 slice or individual brick (1/4 of quart brick, 81 gm)	167				0	80	1	420	03	.15		

No.	Description	Values									
		120	25	74	128	70	61	1	120	03	12
1	1 container 1 1/2 fluid ounces (42 gm)	120	25	74	128	70	61	1	120	03	12
2	1 container 8 fluid ounces (142 gm)	204	57	174	293	175	141	1	740	06	27
353	Jams, marmalades, preserves 1 tablespoon (20 gm)	35	1	1	142	2	2	.1	Trace	Trace	Trace
354	Jellies 1 tablespoon (20 gm)	50	0	0	110	(2)	(2)	(1)	(Trace)	(Trace)	(Trace)
356	Kale, cooked:										
a	1 pound	182	177	27	127	1022	281	100	38 070	72	101
b	1 cup (110 gm)	45	43	7	79	219	69	24	0 220	08	25
358	Kidneys, raw:										
a	Beef, 3 ounces	120	128	60	8	8	188	67	080	72	216
b	Pork, 3 ounces	97	119	30	7	0	209	68	110	70	117
40	Sheep, 3 ounces	80	141	28	0	11	302	78	(080)	66	200
361	Kohlrabi:										
a	Raw 1 cup diced (128 gm)	41	20	1	0.2	0.1	1.0	8	Trace	08	07
362	Cooked:										
a	1 pound	136	95	5	304	11	227	27	Trace	18	18
b	1 cup (155 gm)	4	33	2	104	71	78	0	Trace	06	03
Lamb											
367	Retail items, medium fat:										
a	Rib chop, cooked	1 254	72	105	0	31	600	00	(0)	47	77
b	1 pound with bone	1 900	100	1 0	0	50	048	136	(0)	14	117
c	3 ounces without bone	3 46	20	40	0	0	170	26	(0)	12	22
369	Shoulder roast (whole-sale rib), cooked:										
a	1 pound with bone	1 160	21	05	0	11	670	88	(0)	41	75
b	1 pound without bone	1 551	05	127	0	41	854	128	(0)	55	101
c	3 ounces without bone	293	18	24	0	8	160	22	(0)	10	10
371	Leg roast (wholesale leg), cooked:										
a	1 pound with bone	981	86	68	0	36	923	111	(0)	49	80
b	1 pound without bone	1 241	109	86	0	45	1 167	141	(0)	62	113
c	3 ounces without bone	230	20	16	0	9	210	26	(0)	12	21
372	Canned strained (infant food), 1 ounce	30	44	17	0	5	48	7	(0)	01	07

Note: Asterisk indicates that values are calculated from a recipe; parent values indicate imputed value.

\*Based on 5 pounds of ice cream to the gallon, factory packed.

TABLE 138--CONT'D

FOOD, DESCRIPTION AND APPROXIMATE MEASURE	FOOD EN- ERGY CAL	PRO- TEIN GM	FAT GM	TOTAL CARBO- HY- DRATE GM	CAL- CIUM MG	PHOS- PHO- RUS MG	IRON MG	VITA- MIN A VALUE IU	THIA- MINE MG	RIBO- FLAVIN MG	NIACIN MG	ASCOR- BIC ACID MG
373 Lamb and vegetable soup, canned, strained (infant food) See soup, canned vegetable and lamb	1,084 126	0 0	220 14	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
374 Lemons, refuse, rind and seeds, 38%, 1 medium lemon ( $2\frac{1}{4}$ lb) 2 in, 100 gm) -----	20	6	4	54	23	14	4	0	03	Trace	1	31
Lemon juice												
375 Fresh	59	10	5	189	34	27	2	0	11	01	3	122
1 cup (246 gm) -----	4	1	0	12	2	2	0	0	01	Trace	Trace	7
Canned												
376 Unsweetened	59	10	5	189	34	27	2	0	11	01	3	104
1 cup (246 gm) -----	4	1	0	12	2	2	0	0	01	Trace	Trace	6
1 tablespoon (15 gm) -----												
380 Lettuce, headed, raw	32	26	4	64	48	53	11	1,200	10	.18	4	17
1 head, loose leaf (4 in diam 220 gm) -----												
1 head, compact (4 $\frac{1}{4}$ in diam, 1 pound) -----	68	54	9	132	100	114	23	2,470	20	38	0	35
2 large or 4 small leaves (50 gm) -----	7	6	1	14	11	12	2	270	02	04	.1	4
382 Limes, refuse, rind and seeds, 24%, 1 medium lime (2 in di- am, 68 gm) -----	19	4	1	64	(21)	(11)	(3)	0	(02)	(Trace)	(1)	14
1 lime juice, fresh 3 cup (246 gm) -----	38	10	0	204	(31)	(27)	(2)	0	(11)	(01)	(7)	65

		119	114	41	55	3	276	44	30 730	15	2-25	84	19
38	Liver												
38	Beef, cooked, fried, 2 ounces	120	162	42	34	3	292	10	13 170	18	215	137	30
38	Chaf, raw, 3 ounces	120	189	74	22	14	291	67	27 770	17	210	100	17
38	Chicken, raw, 3 ounces	114	167	41	14	8	304	153	12 070	34	255	142	19
38	Pork, raw, 3 ounces	116	179	33	25	7	309	107	42 030	34	270	143	18
38	Sheep or lamb, raw, 3 ounces												
390	Liver, canned, strained (infant food), 1 ounce	30	45	11	3	7	70	20	5 440	01	61	19	--
	Liver sausage See Sausage												
	Liverwurst See Sausage, liver												
392	lobster, canned 3 ounces	79	156	11	3	35	163	7	--	(03)	06	(19)	--
393	Loganberries raw 1 cup (144 gm)	90	14	9	23 0	70	27	17	(290)	(04)	(10)	(1)	34
	Macaroni												
	Unenriched												
394	Dry												
a	1 cup elbow type (123 gm)	403	157	17	941	27	203	136	(0)	1109	1 46	173	(0)
b	1 cup (1 in pieces 110 gm)	415	141	15	842	24	192	132	(0)	10	07	12	(0)
c	1 cup (2 in pieces 86 gm)	324	110	12	638	10	142	125	(0)	08	05	17	(0)
395	*Cooked												
a	1 pound	679	232	27	1371	41	293	50	(0)	08	08	12	(0)
b	1 cup (1 in pieces or elbow type 140 gm)	209	71	8	423	13	91	8	(0)	03	02	7	(0)
396	Enriched												
Dry													
a	1 cup elbow type (123 gm)	403	157	17	941	27	203	136	(0)	1109	1 46	173	(0)
b	1 cup (1 in pieces 110 gm)	415	141	15	842	24	192	132	(0)	10	07	12	(0)
c	1 cup (2 in pieces 86 gm)	324	110	12	638	10	142	125	(0)	08	05	17	(0)
397	*Cooked												
a	1 pound	678	232	27	1371	41	293	50	(0)	08	08	12	(0)
b	1 cup (1 in sticks or elbow type 140 gm)	209	71	8	423	13	91	15	(0)	03	15	20	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act

## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE IU	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
398	*Macaroni and cheese, baked												
a	1 pound	957	36.8	49.9	89.4	867	767	123	2,050	1.15	1.71	1.18	Trace
b	1 cup (220 gm)	461	17.8	24.2	43.3	420	372	21.1	990	2.07	2.35	2.9	Trace
400	Mackerel, canned, solids and liquids												
401	Atlantic, 3 ounces	155	16.4	9.4	0	157	233	1.8	370	0.5	1.8	4.0	
402	Pacific, 3 ounces	153	17.9	8.5	0	221	245	1.9	20	0.2	2.8	7.4	
403	Mangos, raw, 1 medium (200 gm), refuse, seeds and skin, 34%												
a	Margarine	87	0	3	22.7	12	17	3	8,380	0.8	0.7	1.2	
b	1 cup (224 gm)	1613	13	181.4	9	45	36	0	4,400				
c	1 tablespoon (14 gm)	101	1	11.3	1	3	2	0	400				
	1 pat (64 per pound, 7 gm)	50	0	5.7	0	1	1	0	230				
	Marmalades See Jams, marmalades, preserves												
	Molasses See Salad dressings												
	Meat See Beef, Lamb, Pork, Veal												
	Melons See Cantaloupe, Honey dew, Watermelons												
	Milk, cow												
404	Fluid (pasteurized and raw) Whole												
a	1 quart (976 gm)	666	34.2	38.1	47.8	1,132	1	7	(1,550)	35	1.68	1.1	13
b	1 cup (244 gm)	166	8.5	9.5	12.0	288	227	2	(390)	.09	.42	.3	3
405	Nonfat (skim):												
a	1 quart (984 gm)	350	34.4	1.0	12.5	1,210	954	7	(40)	35	1.75	1.1	13
b	1 cup (246 gm)	87	8.6	.2	3.03	303	239	2	(10)	.09	.44	.3	3
400	Canned, Evaporated (unsweetened), 1 can 1/2	316	17.6	19.9	24.9	612	401	4	1,010	1.2	.91	.5	3

407	Condensed (sweetened), 1 cup (300 gm) -----	0.91	2.14	2.57	107.7	9.75	0.94	6	(1,300)	16	1.10	6	3
	Dried, -----												
	Whole, -----												
408	1 cup (128 gm) -----	6.10	11.0	34.2	48.6	1,235	9.72	7	1,700	70	1.87	4	8
a	1 tablespoon (8 gm) -----	30	2.1	2.1	3.0	76	5.8	0	110	0.2	1.2	1	1
409	Nonfat solids (skim) -----												
a	1 cup (120 gm) -----	13.1	12.7	1.2	62.1	1,500	1,236	7	(700)	1.2	2.75	1.5	2
b	1 tablespoon (7.5 gm) -----	2.9	2.7	1	3.9	98	77	0	(Trace)	0.3	1.5	1	1
	Malted, -----												
410	Dry powder, 1 ounce -----	215	4.1	2.4	20.0	91	107	6	200	0.9	15	--	(0)
411	Beverage, 1 cup (270 gm) -----	251	12.1	11.9	31.9	7.1	172	4	840	14	76	--	7
412	Chloroflate flavored -----												
a	1 quart (1 kg) -----	7.40	32.0	22.0	106.0	1,000	910	7	910	72	1,50	10	10
b	1 cup (250 gm) -----	185	8.0	5.5	26.5	252	222	2	250	0.8	40	2	2
413	Half and half (milk and cream) -----												
a	1 quart (908 gm) -----	1,322	31.0	116.2	13.6	1,015	927	6	1,700	72	152	10	12
b	1 cup (242 gm) -----	330	7.7	29.0	10.9	261	208	1	1,100	0.4	38	2	3
	Buttermilk See Buttermilk -----												
414	Milk, goat, fluid -----												
a	1 quart (976 gm) -----	654	32.2	9.0	44.9	1,253	1,075	10	(1,550)	70	104	2.9	10
b	1 cup (244 gm) -----	164	8.1	0.8	11.2	311	270	2	(300)	10	26	.7	2
	Molasses, cane -----												
415	First extraction or light -----												
a	1 cup (324 gm) -----	825	--	--	2,132	741	118	11.1	--	27	21	8	--
b	1 tablespoon (20 gm) -----	50	--	--	130	11	9	0	--	0.1	0.1	Trace	--
416	Second extraction or medium -----												
a	1 cup (328 gm) -----	762	--	--	916.8	951	226	10.7	--	--	23	2.9	--
b	1 tablespoon (20 gm) -----	46	--	--	120	58	14	1.2	--	--	0.2	.2	--

Note Asterisk indicates that values are calculated from a recipe parent's indicate imputed value

If enriched macarant is used in the recipe the values for iron thiamine riboflavin and niacin would be 12, 0.45 0.91 and 4.1 mg respectively

If enriched macarant is used in the recipe the values for iron thiamine riboflavin and niacin would be 15, 0.22 0.41, and 2.0 mg, respectively

The vitamin values are based on the drained solids

Based on the average vitamin A content of fortified margarine Most of the margarine manufacturers for use in the United States have 15,000 IU of vitamin A added per pound The minimum Federal specifications for fortified margarine require the addition of 9,000 IU of vitamin A per pound

Based on unfortified products

Total sugars



## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD DESCRIPTION AND APPROXIMATE MEASURE		FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
417	Molasses—Cont'd												
a	Third extraction or blackstrap	698			1180.4	1899	279	37.1	--	39	59	5.2	--
b	1 cup (328 gm)	43			111.0	116	17	2.3		0.2	0.4	3	--
418	Birchblossoms				1229.6		164	--		1.0	6.6	--	--
a	1 cup (308 gm)	889			114.0		10			0.1	0.4	--	--
b	1 tablespoon (20 gm)	54											
419	*Muffins made with												
a	Unenriched flour 1 muffin (2½ in diam 48 gm)	134	3.8	4.0	20.2	99	92	3	50	0.2	0.6	2	(0)
b	Enriched flour 1 muffin (2½ in diam 48 gm)	134	3.9	4.0	20.2	99	92	8	50	0.9	1.0	7	(0)
421	Mung bean sprouts raw 1 cup (90 gm)	21	2.6	2	3.7	26	53	7	10	0.6	0.8	5	14
423	Mushrooms canned solids and liquid 1 cup (244 gm)	28	3.4	5	9.0	(17)	(220)	(20)	0	0.4	60	4.8	--
425	Muskmelons See Cantaloupes and Honey dew melon												
a	Mustard greens, cooked	102	10.4	1.4	18.2	999	173	13.2		27	8.2	3.2	20.4
b	1 pound	31	3.2	4	5.6	308	53	4.1		0.9	2.5	1.0	6.3
	1 cup (140 gm)												
426	Noodles (containing egg)												
a	Unenriched												
b	Dry, 1 cup (1½ in strips 73 gm)	278	9.2	2.5	53.4	16	145	1.5		15	0.8	1.7	(0)
427	*Cooked												
a	1 pound	302	10.0	2.7	58.1	18	159	1.8		15	0.9	1.8	(0)
b	1 cup (160 gm)	107	3.5	1.0	20.5	6	56	0.6		0.5	0.3	0.6	(0)
428	Enriched												
a	Dry 1 cup (1½ in strips 73 gm)	9.2					145	2.1	140	2.64	2.27	2.43	(0)

4-1	a	b	*Cooked 1 pound 1 cup (160 gm)	702 10-	100 35	2- 10	291 205	19 6	1-9 36	3 9	1-0 60	67 2	20 10	49 1-	(0) (0)
430			Oat cereal ready to eat (with vitamins and minerals) 1 cup (25 gm) - - -	100	76	19	1-6	40	99	10	(0)	20	0-	5	(0)
			Oatmeal or rolled oats												
431			Dry 1 cup (50 gm)	312	114	59	546	42	224	76	(0)	18	11	9	(0)
432			*Cooked												
a			1 pound	285	103	54	499	41	101	72	(0)	52	10	9	(0)
b			1 cup (216 gm)	149	54	29	260	21	1-9	1-	(0)	22	05	1	(0)
433			Precooked (infant food) by 1 ounce	106	43	14	195	25	226	93	(0)	71	10	-	(0)
434			Oil, salted or cooking												
a			1 cup (220 gm)	194	0	220	0	0	0	0	0	0	0	0	0
b			1 tablespoon (14 gm)	124	0	14	0	0	0	0	0	0	0	0	0
436			Okra cooked												
a			1 pound	149	92	9	736	7-	291	72	3-0	27	7	70	91
b			8 pols (3 in long & in diam 85 gm)	29	13	2	67	0	23	6	6-0	05	05	7	17
			Oleomargarine See Margarine												
			Olives pickled mammoth size (1 $\frac{1}{2}$ by 1 $\frac{1}{4}$ in refuse 16c)												
437			Green 10 olives (65 gm)	22	8	-4	22	49	9	0	160	Trace		-	-
			Ripe												
438			Mission 10 olives (65 gm)	106	10	116	14	49	9	9	40	Trace	Trace		-
439			Other varieties (as ascalano manzanilla and sevillano) 10 olives (65 gm)	20	-	-4	17	49	9	1	20	Trace	Trace		-

Omelet See Eggs omelet

Note Asterisk indicates that values are calculated from a recipe parentages indicate nutrient value

\*Total sugars

<sup>1</sup>Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act

<sup>2</sup>Based on products ranging from 0.4 to 1.2 mg per ounce of cereal. The niacin value of some products is as high as 6.5 mg per ounce

TABLE 138—CONT'D

## COMPOSITION OF FOODS

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD EN FTGY CAL	IRE TLIN GM	FAT GM	TOTAL CARBO HYDRATE GM	CUL CULM MG	IBOS PRO RLS MG	IRON MG	VITA MIN A VALUE IU	THIA MINE MG	PIBO FLAVIN MG	NIACIN MG	ASCOR BIG ACID MG
440	Onions, mature												
a	1 onion (2 1/4 in diam), EP (110 gm)	49	13	2	113	35	48	6	60	04	Trace	2	10
b	1 tablespoon chopped (10 gm)	4	1	0	10	3	4	0	Trace	Trace	Trace	Trace	1
441	Cooked whole	173	45	9	39.5	145	200	23	230	09	.14	9	27
a	1 pound	79	21	4	183	67	92	10	110	04	06	4	13
b	1 cup (210 gm)	23	5	1	53	69	12	4	(30)	(02)	(02)	(1)	12
443	Onions, young green, 6 small onions without tops (50 gm)												
a	1 large (3 1/2 in diam, No 126's, 325 gm)	106	21	5	262	77	54	9	(440)	18	06	6	116
b	1 medium (3 in diam, No 200's, 215 gm)	70	14	3	174	51	36	6	(290)	12	04	4	77
c	1 small (2 1/4 in diam, No 288 s, 150 gm)												
d	1 cup sections (193 gm)	49	10	2	121	36	25	4	(300)	08	.03	3	53
445	Orange juice	87	17	4	216	64	44	8	(360)	13	05	5	95
446	Fresh, 1 cup (246 gm)												
447	Canned, 1 cup (246 gm)	108	20	5	271	47	39	5	(460)	19	06	6	122
	Unsweetered, 1 cup (246 gm)	109	20	5	273	25	14	.7	(240)	17	04	6	103
449	Sweetened, 1 cup (251 gm)	135	15	5	349	25	45	8	(250)	18	05	6	105
449	Orange juice concentrate												
449	Canned, 1 ounce	65	12	2	164	17	25	5	(140)	10	02	3	63
450	Frozen, 1 can (6 fluid ounces, 202 gm)	300	55	14	749	69	121	20	(670)	48	11	15	285
	Oysters, meat only, raw, 1 cup (13 210 gm)	200	23.5	50	134	226	343	134	35	48			

*Oyster stew										
431	1 part oysters to 3 parts milk by volume	113	241	245	241	531	100	68	1,240	20
a	1 pound									
b	1 cup (with 3.4 oysters, 230 gm)	209	122	124	122	20	233	34	650	14
452	1 part oysters to 1 part milk by volume	461	313	250	268	105	551	17.2	1,500	40
a	1 pound									
b	1 cup (with 0.8 oysters, 210 gm)	211	166	132	142	21.2	203	7.0	920	21
*Pancakes (griddlecakes), baked										
Wheat (home recipe)										
With unenriched flour										
453	1 pound	601	709	418	1208	717	690	27	500	26
b	1 cake (4 in diam 2" gm)	70	18	25	72	13	12	3	50	62
454	With enriched flour									
a	1 pound	601	709	418	1208	717	690	39	490	41
b	1 cake (4 in diam 2" gm)	70	18	25	72	13	12	4	50	63
455	Buckwheat with buckwheat pan cake mix									
a	1 pound	708	777	477	949	1111	1013	34	720	72
b	1 cake (4 in diam 2" gm)	47	16	23	56	67	98	7	70	64
Pancake mix, dry self rising										
Wheat (mixed with other flours)										
456	Unenriched 1 cup (130 gm)	471	128	13	987	628	919	27	0	20
457	Enriched 1 cup (135 gm)	471	128	16	987	628	919	15	0	33
458	Buckwheat, 1 cup (135 gm)	432	142	26	949	670	1116	12	0	19
459	Papayas, raw, 1 cup (1/4 in cubes 182 gm)	71	11	2	192	36	29	5	3,190	66
460	Parsley, common raw, 1 table spoon chopped (3.5 gm)	1	1	0	3	1	3	2	290	Trace
462	Parsnips, cooked									
a	1 pound	274	45	23	631	279	707	72	0	27
b	1 cup (155 gm)	94	16	8	215	98	124	11	0	69

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value  
 †Calcium may not be available because of presence of oxalic acid

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD EN-ERGY CAL.	PRO-TEIN GM.	FAT GM.	TOTAL CARBO-HY-DRATE GM.	CAL-CIUM MG.	PHOS-PHORUS MG.	IRON MG.	VITA-MIN A VALUE I U.	THIA-MINE MG.	RIBO-FLAVIN MG.	NIACIN MG.	ASCOR-BIC ACID MG.
Pastry shell, plain See Pie crust													
463	Peaches												
a	Raw												
	skins, 1½ (2½ by 2 in diam, 1½ gm) ---	46	5	1	120	8	22	6	880	02	05	9	8
b	1 cup, sliced (168 gm) ---	77	8	2	202	13	37	10	1,480	04	08	15	13
464	Canned, solids and liquid												
465	Water pack, 1 cup (234 gm) ---	66	12	2	166	12	34	10	1,110	02	05	17	10
a	Syrup pack												
b	1 cup (256 gm) ---	174	10	3	466	13	36	10	1,160	02	05	17	10
466	Strained, bleppons halves and 2 ta												
467	Frozen, 4 ounces (117 gm) ---	79	5	1	213	6	16	5	530	01	02	18	11
468	Dried, 4 ounces	17	2	1	43	2	5	3	180	01	01	8	5
469	Uncooked, 1 cup (160 gm) ---	89	5	1	239	7	17	5	590	01	03	6	1
	*Cooked, no sugar added, 1 cup (10½ halves plus 6 tablespoons liquid, 270 gm) ---	424	48	10	1110	70	202	110	5,200	02	31	86	30
470	*Cooked, sugar added, 1 cup (10½ halves plus 6 spoons liquid, 305 gm) ---	234	24	5	589	38	105	59	2,750	01	16	43	11
471	Peanuts, Virginia type, roasted												
a	Shelled												
b	1 cup medium halves (144 1 tablespoon, chopped (9 gm) ---	366	24	6	955	37	107	58	2,760	01	15	43	12
472	Peanut butter												
a	1 cup (258 gm) ---	805	387	63.6	340	107	566	27	0	42	19	233	(0)
b	1 tablespoon (16 gm) ---	50	24	40	21	7	35	2	0	03	01	15	(0)
	1,486 92	673	1233	542	191	1014	49	0	31	34	418	(0)	(0)
		43	76	34	12	63	3	0	02	02	26	(0)	(0)



## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD EN ENGY CAL	PRO TIN GY	FAT GM	TOTAL CARBO HY DRATE GM	CHL CHOL MG	PHOS PHO MG	IRON MG	VITA MYA VALUF IU	THIA MINE MG	RIBO FLAVIN MO	NIACIN MG	ASCOR BIG ACID MG
186	Peppers, green raw, 1 medium, refuse, stem end, seeds, and core, 16% (76 gm) -----	16	8	1	3.6	7	16	3	400	0.2	0.4	2	77
487	a Cooked, parboiled then baked b 1 pound -----	119 17	5.9 8	9 1	27.2 3.9	50 7	114 16	18 3	3,360 480	18 0.3	32 0.5	18 3	440 0.4
488	Perseimons, Japanese or Kaki, raw, 1 persimmon (2 1/4 in diam, 125 gm) -----	95	1.0	5	24.2	7	31	4	3,270	0.6	0.5	Trace	13
	a Seedless kind, refuse, skin, 3% b Kind with seeds, refuse, skin and seeds, 24% -----	74 15	8 9	1 3	19.0 2.8	6 34	25 97	3 1.6	2,570	0.5	0.4	Trace	10
489	Pickles Dill, cucumber, 1 large (1 1/2 in diam, 4 in long, 135 gm) -----	118	1.5	3	28.9	54	46	3.1	Trace	0.9	1	8	
490	Fresh, cucumber (as bread and butter pickles) 1 cup (22 2/3 slices, 170 gm) 6 slices (3/4 in by 1 1/2 in di- am, 42 gm) -----	29	4	1	7.1	13	11	8	0.4	0.7	.1	15	
491	Sour, cucumber or mixed, (1 1/2 in diam, 4 in long, 135 gm) -----	15	7	3	3.0	34	27	1.6	Trace	0.2	Trace	4	
492	a Sweet, cucumber or mixed diam, or 2 pickles 2 in long, 6 in diam, 20 gm) -----	22	2	1	5.3	3	4	3	20 (0)	Trace	Trace	1	
	b 1 cup, mixed, chopped (210 gm) -----	225	17	8	55.4	34	38	27	240 (0)	0.4	Trace	15	
	c 1 tablespoon, mixed, chopped (13 gm) -----	14	1	1	2	2	2	10	(0)	Trace	Trace	1	





TABLE 138—CONT'D

## COMPOSITION OF FOODS

FOOD EN CAL.	PRO TEIN GM	FAT GV	TOTAL CARBO HY DRATE GM	CAL CIUM MG	PHOS PHO RUS MG	IRON MG	VITA MIN A VALUE IU	THIA MINE MG	RIBO FLAVIN MG	NIAVIN MG	ASCOR BIC ACID MG
499 a b c	Pies—Cont'd Minced 1 pie (9 in diam, 945 gm) — 4 inch sector (or $\frac{1}{4}$ of 9 in diam, 135 gm) — 1 inch sector (of 9 in diam, 34 gm) —	2,386 341 85	23 6 3 4 8	63 2 9 3 2 3	151 22 5	378 54 14	70 10 Traces	64 09 02	33 05 01	33 5 1	0 1 Trace
500 a b c	*Pumpkin 1 pie (9 in diam, 910 gm) — 4 inch sector (or $\frac{1}{4}$ of 9 in diam, 130 gm) — 1 inch sector (of 9 in diam, 32 gm) —	1,842 263 66	38 2 5 5 14	234 8 12 5 3 1	491 70 18	737 103 26	Traces 17,350 2,480	02 30 04	01 1 08 15	1 29 4	Trace 2 (0)
501 a b	Pie crust, plain *Baked with Unenriched flour 1 lower crust, 9 inch shell (135 gm) — 1 double crust, for 9 inch pie (270 gm) —	637 101 202	36 3 72 6 143 4	71 7 15 30	88 176	7 14	0 0	03 06	.7 1 4	(0) (0)	
502 a b	Enriched flour 1 lower crust, 9 inch shell (135 gm) — 1 double crust, for 9 inch pie (270 gm) —	637 101 202	36 3 72 6 143 4	71 7 15 30	88 176	27 54	0 0	03 06	.7 1 4	(0) (0)	
503	Unbaked Pie (270 gm) — pound (fresh or frozen), 1 pound	637 101 202	36 3 72 6 143 4	71 7 15 30	88 176	27 54	0 0	03 06	.7 1 4	(0) (0)	
504	Pimientos, canned, 1 medium (38 gm) —	1,946 300	107 6 212 0	41 259	6 870	01 02	1 36				
505 a b	Pineapple Raw 1 cup, dried (140 gm) —	10 3 6	2 2 2 3	22 19 2 22	15 4	0 12	3 33				

		14	3	2	115	13	9	7	110	07	(02)	2	20
506	1 cup (1 in thick 3 1/2 in diam) syrup pack whole and 1 qt 1	204	10	3	140	55	18	14	210	50	04	4	27
	1 cup crushed (270 gm)												
	2 small or 1 large plus 2 tal spoons juice (122 gm)	65	5	1	257	35	9	7	100	09	02	2	11
507	1 dozen 4 ounces	67	5	2	252	16	11	7	110	07	02	2	22
508	Pineapple juice cannel 1 cup (246 gm)	121	-	2	724	75	20	12	200	17	04	4	22
510	Plums (all excluding prunes) raw												
a	1 plum (2 in diam (6 gm) refuse pits 5cc	20	4	1	54	10	11	7	200	04	02	7	3
b	1 cup halves (2 in diam 165 gm)	94	17	4	239	71	35	9	450	12	09	7	9
511	Plums (Italian prunes canned syrup pack												
a	1 cup fruit and juice 250 gm) refuse pits 4cc	140	10	2	502	50	70	27	540	05	06	7	3
b	3 prunes (without pits) plus 2 tal spoons juice (125 gm)	92	5	1	249	10	11	17	280	03	07	7	1
513	Popcorn Popped 1 cup (14 gm) Pork fresh	54	19	-	105	(2)	(39)	(4)	(0)	(03)	(02)	(7)	(0)
	Retail items cooked												
518	Ham												
a	1 pound with bone	143	86	118	0	79	854	111	(0)	1 00	86	169	0
b	1 pound without bone	1418	109	150	0	50	1091	141	(0)	2 40	1 09	213	0
c	3 ounces with out bone	338	20	29	0	9	202	26	(0)	45	20	40	0
520	Loin or chops												
a	1 pound with bone	1119	79	90	0	39	911	104	(0)	2 86	93	174	0
b	1 pound without bone	1508	104	118	0	50	1067	136	(0)	3 77	1 09	228	0
c	1 chop (115 gm)	693	20	23	0	10	204	26	(0)	72	21	44	0
d	3 ounces without bone	284	20	22	0	9	200	26	(0)	71	20	41	0

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value. The proximate constituents calcium, phosphorus, and vitamin A are calculated from a recipe.

TABLE 138--CONT'D

FOOD DESCRIPTION, AND APPROXIMATE MEASURE		FOOD ENERGY CAL	PROTEIN GM	FAT GV	TOTAL CARBOHYDRATE GRAM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE IU	THIAMINE MG	RIBOFLAVIN MG	NIACIN MC	ASCORBIC ACID MG
523	Pork, cured												
a	Ham, smoked, cooked	1,496	87	124	(15)	38	626	109	(0)	204	80	157	0
b	1 pound with bone	1,804	104	130	(18)	45	754	132	(0)	246	96	189	0
c	1 ounce without bone	339	20	28	(3)	9	141	25	(0)	46	18	35	0
524	Luncheon meat												
525	Boiled ham, 2 ounces	172	129	129	0	5	52	15	(0)	57	.15	29	0
	Canned, spiced, 2 ounces	164	84	138	9	5	91	12	(0)	18	.12	16	0
527	Sausage, pork links or bulk, raw												
	See Sausage, pork food), 1 ounce												
529	Potatoes												
a	Cooked	36	48	17	0	4	51	5	(0)	10	08	13	0
b	Baked												
	1 pound												
	1 medium potato (2½ in diam., peeled, 99 gm, or unpeeled, 128 gm, refuse, 23%)	446	109	5	102.2	59	300	36	110	50	21	04	77
530	Boiled, unpeeled before cooking												
a	ing	97	24	1	22.3	13	65	8	20	11	05	14	17
b	1 pound, refuse, cooked skins, 5%	359	86	4	82.3	47	241	30	80	43	17	50	66
	1 medium potato (2½ in diam., peeled, 142 gm, or unpeeled, 150 gm, refuse, 5%)												
531	Boiled, peeled before cooking												
a	1 pound	118	28	1	27.1	16	80	10	30	14	06	16	22
b	1 medium potato (2½ in diam.) or 1 cup diced (126 gm)	378	91	3	86.7	50	254	32	80	43	.15	46	62
		105	25			14	71	9	20	12	01	13	17

538	100 gm 100 gm
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## COMPOSITION OF FOODS

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE		FOOD ENERGY CAL.	PROTEIN GM.	FAT GM.	TOTAL CARBOHYDRATE GM.	CALCIUM MG.	PHOSPHORUS MG.	IRON MG.	VITAMIN A VALUE I U.	THIAMINE MG.	RIBOFLAVIN MG.	NIACIN MG.	ASCORBIC ACID MG.
544	Prunes, dried, unsulfured												
a	Uncooked												
	4 large prunes, refuse, pits, 12% (40.50 per lb 1-3 by 1 by 3/4 in, 40 gm)	94	8	2	24.8	19	30	1.4	660	0.03	0.06	0.6	1
b	4 medium prunes, refuse, pits, 15% (50.60 per lb, 1 1/2 by 1 by 1/2 in, 32 gm)	73	6	2	19.2	15	23	1.1	510	0.03	0.4	5	1
c	4 small prunes, refuse, pits, 18% (70.80 per lb, 1 1/2 by 1 by 1/2 in, 34 gm)	54	5	1	14.2	11	17	8	380	0.02	0.3	3	1
d	1 cup medium, refuse, pits, 15% (165 gm)	375	32	8	99.4	76	119	5.5	2,050	.14	2.3	2.4	4
545	*Cooked, no sugar added (medium size), prunes and liquid, refuse, pits, 8%												
a	1 pound	523	46	13	137.9	104	167	7.5	3,720	1.3	3.3	3.4	4
b	1 cup, 10 1/8 prunes and 1/2 cup liquid (370 gm)	310	27	7	81.8	62	99	4.5	2,910	0.7	2.0	2.0	2
546	*Cooked, sugar added (medium size), prunes and liquid, refuse, pits, 7%												
a	1 pound	695	42	8	182.3	93	143	6.3	3,160	1.3	2.5	2.5	4
b	1 cup, 10 1/8 prunes and 1/2 cup liquid (315 gm)	483	29	6	126.6	64	100	4.4	2,200	0.9	1.8	1.8	3
547	Prunes, canned, strained (infant food), 1 ounce												
a	1 ounce	28	3	1	7.2	8	4	210	0.1	0.1	2	1	1
b	1 cup (135 gm)	170	10	0	46.3	(60)	(96)	4.3	(.07)	(.19)	1.0	(2)	(2)
548	Prune juice, canned, 1 cup (240 gm)												
a	1 pound	674	14	168.4	118	191	82	3,910	17	40	3.3	3.3	3
b	1 cup (135 gm)	200	4	50.1	35	57	24	1,160	0.5	1.5	1.0	1.0	3

Pudding, vanilla No. 1000										
551	Pumpkin, canned, 1 cup (2.8 gm)	76	23	7	190	(46)	(82)	(16)	7,750	01
552	Radish, raw, 4 small (40 gm), refuse, tops and roots, 51%	4	2	0	9	7	6	2	10	01
<i>Raisins</i>										
553	Dried, unsulfured									
a	1 cup (160 gm)	429	37	9	1139	125	206	53	90	24
b	1 tablespoon (10 gm)	26	2	0	71	8	13	3	Trace	02
554	*Cooked, sugar added, 1 cup (293 gm)	572	32	6	1507	112	186	47	60	19
555	Raspberries									
a	Black, raw, 1 cup (134 gm)	100	20	21	210	54	50	12	0	01
556	Red									
a	Raw, 1 cup (123 gm)	70	15	5	170	49	46	11	160	03
557	Frozen, 3 ounces	94	7	3	210	24	22	5	70	01
<i>Rhubarb</i>										
558	Raw 1 cup diced (122 gm)	19	6	1	46	1	30	6	40	01
559	*Cooked, sugar added									
a	1 pound	639	18	5	1634	156	91	19	110	07
b	1 cup (272 gm)	383	11	3	979	112	54	11	70	02
	Canned in syrup									
560	Rice									
a	Brown raw, 1 cup (208 gm)	748	156	35	1616	81	630	42	(0)	66
561	Converted									
562	Raw, 1 cup (187 gm)	677	142	6	1485	45	254	13	(0)	39
a	*Cooked									
b	1 pound	525	109	5	1153	36	195	14	(0)	25
	1 cup (176 gm)	204	42	2	447	14	76	5	(0)	10
563	White or milk									
a	Raw, 1 cup (191 gm)	692	145	6	1517	46	260	15	(0)	13
564	*Cooked									
a	1 pound	542	114	5	1189	56	204	14	(0)	06
b	1 cup (108 gm)	201	42	2	440	13	76	5	(0)	02
565	Presoaked, dry, 1 cup (110 gm)	420	97	2	916	4	73	9	(0)	02

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value.  
 \*Calcium may not be available because of presence of oxalic acid.

TABLE 138—CONT'D

FOOD EX- TRY CAL	PRO- TEIN GM	FAT GM	TOTAL H2O DRAFT CM	CAL CHIL MC	PHOS- PHO- PUS MG	IRON MG	VITA- MIN A VALUE IU	THIA- MINE MG	RIBO- FLAVIN MG	NIACIN MG	ASCOR- BIC ACID MG
<b>Rice products</b>											
366 Flakes, 1 cup (30 gm) -----	118	2	263	6	35	5	(0)	02	03	3	(0)
367 Flakes (added thiamine and niacin), 1 cup (30 gm) -----	118	2	263	6	35	5	(0)	14	03	16	(0)
368 Puffed, 1 cup (14 gm) -----	55	1	123	3	16	3	(0)	01	01	1	(0)
369 Puffed (added thiamine and niacin), 1 cup (14 gm) -----	55	1	123	3	16	3	(0)	06	01	9	(0)
<b>Rice, wild. See Wild rice</b>											
<b>Rolls</b>											
370 Plain unenriched (pan rolls)											
a 1 roll (16 per lb, 28 gm) -----	86	15	154	15	27	2	0	02	03	3	(0)
b 1 roll (12 per lb, 33 gm) -----	118	21	209	21	36	3	0	02	04	4	(0)
c 1 roll (8 per lb, 57 gm) -----	176	31	314	31	55	4	0	03	06	6	(0)
371 Plain, enriched (pan rolls)											
a 1 roll (16 per lb, 28 gm) -----	96	15	154	15	27	5	0	07	04	6	(0)
b 1 roll (12 per lb, 33 gm) -----	118	21	209	21	36	7	0	09	06	8	(0)
c 1 roll (8 per lb, 57 gm) -----	176	31	314	31	55	10	0	14	09	13	(0)
<b>Sweet</b>											
372 Unenriched											
a 1 package (6 rolls 330 gm)	1,065	257	1775	209	343	20	0	18	44	33	(0)
b 1 roll (55 gm)	178	43	296	35	57	3	0	03	07	6	(0)
373 Enriched											
a 1 package (6 rolls 330 gm)	1,065	257	1775	209	343	159	0	80	51	73	(0)
b 1 roll (55 gm)	178	43	296	35	57	110	0	13	08	12	(0)
375 Rutabagas cooked											
a 1 pound	145	5	340	250	186	18	1590	23	32	32	97
b 1 cup cut or shredded (155 gm)	50	2	116	85	64	6	540	08	11	11	33
<b>Rye bread. See Breads</b>											
576 Rye flour, light, 1 cup, sifted (80 gm)											
580 Rye wafers or "Swedish health bread," 2 wafers (17 gm, by 314 in 13 gm)	286	75	623	18	149	9	(0)	12	06	5	(0)
44	16	2	99	6	52	6	(0)	04	03	2	(0)

Solid dressings											
581	Commercial, plain (mayonnaise type) 2.										
a	1 cup (245 gm) ---	002	26	96.5	327	21	70	9	340	01	07
b	1 tablespoon (15 gm) ---	54	2	5.5	21	1	4	1	20	Trace	Trace
582	French										
a	1 cup (240 gm) ---	945	14	85.2	487	(0)	(0)	(0)	(0)	(0)	(0)
b	1 tablespoon (15 gm) ---	50	1	5.3	30	(0)	(0)	(0)	(0)	(0)	(0)
583	*Home cooked, bottled										
a	1 cup (270 gm) ---	446	12.2	27.0	401	243	275	19	1,350	16	46
b	1 tablespoon (15 gm) ---	28	8	1.7	26	15	17	1	80	01	03
584	Mayonnaise										
a	1 cup (205 gm) ---	1,451	31	159.0	62	39	123	20	430	07	07
b	1 tablespoon (15 gm) ---	92	2	10.1	4	2	9	1	30	Trace	Trace
Salad oil See Oils salad, or cooking											
Salmon											
Cooked, Pacific broiled or baked											
585	1 steak (4 by 3 by 1½ in, 120 gm) ---	204	23.6	6.5	2	--	500	14	--	12	33
Canned, solids and liquid (including bones)											
587	Chinook or King, 3 ounces---	173	16.8	11.2	0	3 131	246	9	200	02	12
588	Clam, 3 ounces ---	118	18.3	4.4	0	3 212	290	6	50	02	13
589	Coho or silver, 3 ounces ---	140	17.9	7.1	0	3 197	216	3	70	02	13
590	Pink or humpback, 3 ounces---	122	17.4	5.3	0	3 159	243	7	60	03	16
591	Sockeye or red, 3 ounces ---	147	17.2	8.2	0	3 220	293	10	200	03	14
Sardines											
Atlantic type, canned in oil											
592	Solids and liquid, 3 ounces---	288	17.9	23.0	9	301	369	30	--	(01)	(12)
593	Drained solids, 3 ounces---	182	21.9	9.4	10	328	498	23	190	01	15

Note Asterisk indicates that values are calculated from a recipe, parentheses indicate imputed value.

\*Iron, thiamine, riboflavin, and niacin are based on the minimum level of enrichment specified in the standards of identity of breads proposed by the Federal Security Agency and published in the Federal Register, August 3, 1943

\*If bones are discarded, calcium content would be much lower. Bones equal about 2% of total contents of can



## COMPOSITION OF FOODS

EX-138-CONT'D

FOOD EN- ERGY CAL	PRO- TEIN GM	FAT GM	TOTAL CARBO- HY- DRATE GM		CAL- CIUM MG	PHOS- PHO- RUS MG	IRON MG	VITA- MIN A IU	THIA- MINE MG	RIBO- FLAVIN MG	NIA- CIN MG	ACID MG
			FAT GM	CARBO- HY- DRATE GM								
FOOD DESCRIPTION, AND APPROXIMATE MEASURE												
Sardines—Cont'd												
171	151	11.5	6	14	(324)	(143)	(35)	(20)	(01)	(26)	(63)	(0)
184	151	12.6	14		324	143	35	20	01	23	45	(0)
Natural pick, 3 ounces ---												
394	39	2.6	5	80	45	42	(12)	80	08	15	3	38
395	90	6.4	14	200	163	92	(23)	190	15	29	5	74
	32	2.1	4	66	54	27	(8)	60	05	10	2	24
Tomato sauce, 1 cup (253)												
Sauerkraut, canned												
596	90	6.4	14	200	163	92	(23)	190	15	29	5	74
597	32	2.1	4	66	54	27	(8)	60	05	10	2	24
Dried solids												
1 pound	1,003	67.2	72.2	163	(41)	(508)	100	(0)	80	85	12.2	0
1 cup (150 gm)	467	31.2	33.5	7.6	(19)	(230)	4.6	(0)	37	40	5.7	0
Sausage												
1 pound (1 by 2 1/2 in diam)	1,003	67.2	72.2	163	(41)	(508)	100	(0)	80	85	12.2	0
1 piece (1 by 1 1/2 in diam)	467	31.2	33.5	7.6	(19)	(230)	4.6	(0)	37	40	5.7	0
1 3/4 gm	113	6.4	9.1	1.9	9	27	2.2	5.4	(0)	83	11.3	0
Frankfurter, cooked	124	7	10	1	9	3	2.7	6	(0)	83	11.3	0
1 pound	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter (51 gm)	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 8 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 16 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 32 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 64 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 128 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 256 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 512 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1024 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2048 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4096 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 8192 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 16384 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 32768 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 65536 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 131072 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 262144 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 524288 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1048576 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2097152 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4194304 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 8388608 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 16777216 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 33554432 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 67108864 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 134217728 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 268435456 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 536870912 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1073741824 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2147483648 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4294967296 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 8589934592 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 17179869184 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 34359738368 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 68719476736 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 137438953472 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 274877906944 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 549755813888 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1099511627776 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2199023255552 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4398046511104 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 8796093022208 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 17592186044416 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 35184372088832 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 70368744177664 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 140737488355328 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 281474976710656 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 562949953421312 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1125899906842624 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2251799813685248 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4503599627370496 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 9007199254740992 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 18014398509481984 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 36028797018963968 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 72057594037927936 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 144115188075855872 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 288230376151711744 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 576460752303423488 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1152921504606846976 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 2305843009213693952 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 4611686018427387904 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 9223372036854775808 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 18446744073709551616 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 36893488147419103232 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 73786976294838206464 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 147573952589676412928 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 295147905179352825856 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 5902958103587056517056 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 11805916207174113034112 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 23611832414348226068224 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 47223664828696452136448 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 94447329657392904272896 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 188894659314785808545792 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 377789318629571617091584 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 755578637259143234183168 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1511157274518286468366336 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 3022314549036572936732672 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 6044629098073145873465344 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 12089258196146291746930688 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 24178516392292583493861376 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 48357032784585166987722752 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 96714065569170333975445504 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 193428131138340667950891008 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 386856262276681335901782016 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 773712524553362671803564032 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 1547425049106725343607128064 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 3094850098213450687214256128 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frankfurter, 6189700196426901374428512256 ounces	150	9.5	11.7	2.6	12	4	3.1	7	(0)	83	11.3	0
1 frank												

(08)	Short read (2 squares, 1 1/4 by 1 1/4 in 16 gm) -	91	11	19	10 3	2	9	1	0	01	Trace	1	(0)
608	Runy cannel												
609	Dry pack or brand = lads of wet pack, 3 ounces	109	22.8	1.2	-	98	22	20	50	01	03	11	(0)
610	Wet pack solids and liquid = ounces	76	15.9	9	■	50	12	15	50	01	03	12	(0)
611	Syrup (table blends (chiefly corn syrup))	919	(0)	(0)	(242.7)	151	52	13 1/2	0	0	03	3	(0)
a	1 cup (328 gm)	7	(0)	(0)	(14.8)				0	0	Trace	Trace	(0)
b	1 tablespoon (20 gm)												
	Soups cannel												
612	Bean	491	21	12.9	73.6	714	236	61		35	23	22	--
613	Condensed 11 ounces Ready to serve 1 cup (250 gm)	191	9.5	5.0	29.2	91	102	2.9	-	10	10	1	--
614	Beef	249	10.0	8.4	2.9	37	156	9		--	-		--
615	Condensed 11 ounces Ready to serve 1 cup (250 gm)	100	6.0	3.5	11.0	13	62	5	--	-			--
616	Roast beef and consommé	26	(6)		(0)	6	59	2.9	0	0	12	16	0
617	Condensed 11 ounces Ready to serve 1 cup (240 gm)	9	(2)		(0)	2	24	1.0	0	0	03	6	0
618	Chicken												
619	Condensed 11 ounces	187	8.4	5.9	24.6	47	47	9	-	06	34	37	-
620	Ready to serve 1 cup (250 gm)	75	3.5	2.5	9.5	20	20	5	-	02	12	11	-
621	Strained infant food, 1 ounce	17	9	7	17	11	13	1	70	Trace	03	1	Trace
622	Chicken chowder												
623	Condensed 11 ounces Ready to serve 1 cup (255 gm)	210	10.9	5.9	30.2	94	197	8.7	-	--	--	-	--
624		86	4.6	2.3	12.5	3	76	30	-	--	--	-	--

Note: Asterisk indicates that values are calculated from recipe; parentheses indicate imputed value.

Bar 1 on 68 pounds to the gallon factory packed.

All ready to serve soups are calculated from equal weights of the condensed soup and water except cream soup which was based on equal weights of the condensed soup and milk.

TABLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD EN PROXY CAL	PRO TEIN GM	FAT GM	TOTAL CARBO HY DRATE GM	CAL CIUM MC	PHOS PHS MC	IRON MG	VITA MIN A VALU IU	THIA MINE MG	RIBO PTAIN MG	NIAIN MG	ASCOI BIC ACID MG
Soups, canned—Cont'd												
Cream soup (asparagus, celery, or mushroom)	270	69	16.2	29.6	162	140	0	500	12	53	3	3
623 Condensed, 11 ounces												
624 Ready to serve, 1 cup	201	71	11.7	18.4	217	176	5	200	0.5	20	1	(0)
Condensed, 11 ounces												
625 (255 gm)	16	1.2	3	2.0	5	18	5	1,340	0.2	12	5	1
Liver soup, strained (infant food), 1 ounce	291	15.3	10.9	32.4	206	215	0	60	0.6	05	7	0
626 Noodle rice or barley												
627 Condensed, 11 ounces	117	60	4.5	13.0	82	85	2	30	0.2	19	3.1	0
Ready to serve, 1 cup												
628 (250 gm)	357	16.2	5.0	63.6	81	249	37	(1,120)	4.1	07	12	5
Pea												
629 Condensed, 11 ounces	141	6.1	2.0	25.0	32	98	15	(440)	17	23	1.1	22
Ready to serve, 1 cup												
630 (245 gm)	230	5.6	5.6	45.5	05	97	22	(3,120)	0.3	10	7	10
Tomato												
631 Condensed, 11 ounces	90	2.2	2.2	17.9	24	30	10	(1,230)	12	19	2.5	10
Ready to serve, 1 cup												
632 (245 gm)	203	10.3	4.4	35.9	81	125	19	--	--	08	10	8
Vegetable												
633 Condensed, 11 ounces	82	4.2	1.8	14.5	32	50	8	--	700	02	02	Trace
Ready to serve, 1 cup												
634 (250 gm)	12	7	1	2.6	7	11	3			01	3	Trace
Strained (infant food), 1 ounce												
635 Vegetable and lamb soup, strained (infant food), 1 ounce	14	7	3	2.2	0	10	2	740	0	12	0.5	Trace
Soups, dehydrated												
636 Navy bean, 1 ounce												
637 Pea, 1 ounce	92	5.0	3	17.8	38	120	2.6	0	60	16	0.5	Trace
638 Soybeans, whole, mature, dried, 1 cup (210 gm)	93	5.4	3	17.3	19	103	1.5	15				Trace
	695	7.3	38.0	37.1	477	1,231	16.4	270	2.53			Trace

630	85	84	49	36	120	114	19	0"	06	4	(0)
640	230	451	11	3391	219	629	131	70	33	29	(0)
641											
642	232	374	37	3327	215	537	114	100	30	23	(0)
	365	386	90	3513	337	942	179	179	46	36	(0)
643	230	259	148	3215	140	399	87	100	20	16	(0)
644	38	39	17	24	24	53	9	10	0	3	(0)
645	40	66	15	57	51	72	11	100	21	9	14
646											
647	364	120	13	719	21	157	14	(0)	06	19	(0)
648	678	232	27	1371	41	293	27	(0)	08	22	(0)
649	218	74	9	441	13	95	9	(0)	02	7	(0)
650											
651	354	120	13	719	21	153	427	(0)	4 35	4 56	(0)
652											
653	678	232	27	1371	41	293	50	(0)	47	64	(0)
654	218	74	9	441	13	95	16	(0)	13	21	(0)
655											
656	22	26	3	36	42	62	34	10680	23	7	6"

\* Asterisk indicates that values are calculated from a recipe parentheses indicate multiple values

may be an real with farinaceous flour up to 15%

Test 2: 100 g flour up to 15%

approximately 40% of this total amount of carbohydrate calculated by difference is sugar starch and dextrin. The remaining portion is made up of materials thought to be utilized only poorly if at all by the body.

<sup>1</sup>Iron, folic acid, and vitamin B<sub>12</sub> are based on the minimum level of enrichment specified in the standard of identity for multivitamin (1 unit per 100) Drug and Cosmetic Act.

<sup>6</sup>Cytetium) a) not be available because of presence of oxalic acid

TABLE 138—CONT'D

FOOD EN- ERY CAL	FOOD DESCRIPTION, AND APPROXIMATE MEASURE	PRO- TEIN GM	FAT GM	TOTAL CARBO- HY- DRATE GM	CAL- CU- LUM MG	PHOS- PHO- RUS MG	IRON MG	VITA- MIN A VALUE I U	THIA- MINE MG	RIBO- FLAVIN MG	NIA- CIN MG	ASCO- RIC ACID MG
650	Spinach—Cont'd											
a	Cooked	115	27	163	1563	150	91	53,480	16	91	27	136
b	1 pound	46	11	65	1223	59	36	21,200	14	36	11	54
	Canned											
651	Solids and liquid, 1 cup (232 gm)	45	9	70	1209	77	37	15,750	04	23	8	34
652	Drained solids											
a	1 pound	115	27	163	1563	150	91	34,650	10	54	18	65
b	1 cup (180 gm)	46	11	65	1223	59	36	13,740	04	21	7	26
653	Strained (infant food), 1 ounce	4	5	7	122	11	4	1,190	01	03	1	2
654	Squash summer, cooked, diced											
a	1 pound	74	5	177	68	69	18	1,180	18	32	27	50
b	1 cup (210 gm)	34	13	82	32	32	8	550	08	15	13	23
	Squash winter											
	Cooked											
655	Baked mashed											
a	1 pound	215	18	500	109	150	36	23,100	23	68	27	31
b	1 cup (205 gm)	97	8	226	49	72	16	12,690	10	31	12	14
660	Boiled, mashed											
a	1 pound	171	14	400	86	127	27	23,470	19	45	18	23
b	1 cup (228 gm)	86	7	201	43	64	14	11,290	09	23	9	11
661	Canned, strained (infant food), 1 ounce	8	3	19	9	5	1	560	01	02	(1)	1
662	Starch, pure (including arrowroot, corn etc)											
a	1 cup (128 gm)	461	6	1114	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b	1 tablespoon (8 gm)	29	0	70	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
663	Strawberries											
a	Raw, capped 1 cup (149 gm)	54	13	154	42	40	12	90	04	10	4	80
664	Frozen 3 ounces	90	5	226	19	19	5	30	02	04	2	35

Unit	Calcium	Phosphorus	Vitamin A	Vitamin B <sub>1</sub>	Vitamin B <sub>2</sub>	Vitamin C	Thiamin	Riboflavin	Niacin	Pantoic acid	Ascorbic acid	Iron	Copper	Zinc	Manganese	Selenium	Chlorine	Sulfur	Calcium	Phosphorus	Vitamin A	Vitamin B <sub>1</sub>	Vitamin B <sub>2</sub>	Vitamin C	Thiamin	Riboflavin	Niacin	Pantoic acid	Ascorbic acid	Iron	Copper	Zinc	Manganese	Selenium	Chlorine	Sulfur	
6-1	1 cup (200 gm)	70	(0)	(0)	100	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-2	1 tablespoon (12 gm)	48	(0)	(0)	12	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-3	1 teaspoon (4 gm)	16	(0)	(0)	4	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-4	1 piece, lump sugar (114 gm)	-	(0)	(0)	70	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-5	1 cup sugar (stirred before measuring 128 gm)	493	(0)	(0)	174	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-6	1 tablespoon (8 gm)	31	(0)	(0)	80	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-7	Brown	913	(0)	(0)	210	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-8	1 cup firm packed (220 gm)	913	(0)	(0)	210	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-9	1 tablespoon (14 gm)	31	(0)	(0)	80	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-10	Maple 1 piece (1 1/2 by 1 1/2 by 1/2 in 20 gm)	104	(0)	(0)	27	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	
6-11	Sweet 1 of it as (cooked)	611	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100	41	100
6-12	Bake 1	163	26	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41	11	41
6-13	1 pound 1	560	82	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106	32	106
6-14	1 sweet potato peeled (5 lb 2 1/2 in 205 gm)	252	37	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57	14	57
6-15	(unlied)	813	68	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164	16	164
6-16	1 pound 1	314	26	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	
6-17	1 small sweet potato (3 1/2 by 2 1/2 in 175 gm)	233	44	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54	2	54
6-18	Canne 1 vacuum or solid pack 1 cup (215 gm)	223	34	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0
6-19	Swordfish (cooked, broiled 1 stick (3 by 3 by 1/2 in 175 gm)	223	34	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0	83	0

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value. Calcium may not be available because of presence of oxalic acid. Calcium and phosphorus are based on dark brown sugar; values would be lower for light brown sugar. If very pale varieties only were used, the vitamin A value would be very much lower.

TABLE 138—CONT'D

FOOD EN- ERGY CAL.	PRO- TEIN GM.	FAT GM.	TOTAL CARBO- HY- DRATE GM.	CAL. CH'EM MC.	PHOS- PHO- RUS MG.	IRON MG.	VIT' MIN. A VALUE IU.	THIA- MINE MG.	PIBO- FLAVIN MG.	NIACIN MG.	ASCOR- BIC ACID MG.
680 Tangerines (including other Man- darin type oranges), 1 medium tangerine (2½ in diam, 114 gm) -----	35	6	2	88	(27)	(19)	(3)	(340)	06	(02)	25
Tangerine juice, unsweetened											
681 Fresh, 1 cup (246 gm) -----	95	22	7	226	47	39	(5)	(1,040)	17	(06)	75
682 Canned, 1 cup (246 gm) -----	95	22	7	226	47	39	5	(1,040)	(06)	(06)	(64)
683 Tapioca dry, 1 cup, granulated quick cooking, stirred (152 gm)	547	9	3	1313	18	18	(15)	(0)	(0)	(0)	(0)
Tomatoes											
684 Raw											
a 1 medium EP (2 by 2½ in, 150 gm) -----	30	15	4	60	16	40	9	1,640	06	8	35
b 1 small EP (1½ by 2¼ in, 110 gm) -----	22	11	3	44	12	30	7	1,210	05	6	26
685 Canned or cooked, 1 cup (242 gm) -----	46	24	5	94	(27)	(65)	(15)	2,540	08	17	40
686 Tomato juice, canned, 1 cup (242 gm) -----	50	24	5	104	(17)	(36)	(10)	2,540	07	18	38
687 Tomato catsup											
a 1 cup (273 gm) -----	268	55	11	669	33	49	22	(5,130)	19	61	31
b 1 table-spoon (17 gm) -----	17	3	1	42	2	3	1	(320)	01	1	2
689 Tomato puree, canned, 1 cup (249 gm) -----	90	45	12	179	(27)	(92)	(27)	4,680	17	45	69
Tomato soup: See Soups, canned, tomato											
690 Tongue, beef, medium fat, raw, 4 ounces -----	235	186	17	5	10	212	32	(0)	14	57	(0)
691 Tortillas, 1 tortilla (5 in diam, 20 gm) -----	50	12	(6)	97	22	37	4	1	04	2	--

		24"	0.2	17.9	0	0	11.6	227	10.3	1.0	(150)	(04)	(08)	(11)	(01)
602	1 can fish canned	24"	0.2	17.9	0	0	11.6	227	10.3	1.0	(150)	(04)	(08)	(11)	(01)
603	Solids and liquid 3 ounces	100	247	7.0	0	0	3.6	72	3.1	1.2	70	01	10	10.1	(0)
604	Drained solids, 3 ounces														
604	Turkey, medium fat, raw, 4 ounces	104	8	8	0	0	1	203	4.3	Trace	Trace	10	16	1.1	(0)
605	Turnips														
605	Raw, 1 cup diced (134 gm)	43	1.3	1	0	0	14	46	7	Trace	Trace	07	00	6	28
606	Cooked														
606	1 pound	122	16	9	2.1	0.3	192	154	2	Trace	Trace	18	27	1.8	82
607	1 cup diced (130 gm)	42	12	1	0.3	0.3	12	73	8	Trace	Trace	06	00	0	28
608	Turnip greens														
608	Cooked														
608	Boiled in small or moderate amount of water until tender														
609	1 pound	130	132	1.9	24.2	7.8	11.6	227	10.3	48.120	48.120	1.7	1.80	3.2	272
609	1 cup (145 gm)	43	42	6	7.8	7.8	3.6	72	3.1	15.370	15.370	00	50	1.0	87
610	Boiled in large amount of water long time														
610	1 pound	130	132	1.9	24.5	7.8	11.6	227	10.3	48.120	48.120	23	1.63	2	204
610	1 cup (140 gm)	43	42	6	7.8	7.8	3.6	72	3.1	15.370	15.370	07	52	1	65
611	Canned, solids and liquid, 1 cup (232 gm)	41	35	7	7.4	7.4	232	70	3	10.210	10.210	03	21	1.7	45
612	Veal, cooked														
613	Cutlet (wholesale round)														
613	1 pound without bone	993	127	50	0	0	54	1,171	13.9	(0)	(0)	37	21.06	22.5	0
614	3 ounces without bone	184	24	9	0	0	10	219	3.0	(0)	(0)	2.07	2.24	2.52	0
615	Shoulder roast (wholesale chuck)														
615	1 pound with bone	762	94	40	0	0	40	867	12.1	(0)	(0)	44	1.05	2.1	0
615	1 pound without bone	1,029	127	54	0	0	54	1,171	16.3	(0)	(0)	60	1.42	2.8	0
615	3 ounces without bone	193	24	10	0	0	10	219	3.1	(0)	(0)	11	2.27	2.7	0

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value.

\* Vitamin A value of tortillas made from yellow corn tortillas made from white corn have no vitamin.

Data assume cut to be prepared by braising or pot roasting. Use of proportionate quantity of drippings would add approximately 50% more thiamine and niacin and 25% more riboflavin.



## COMPOSITION OF FOODS

TABLE 138--CONT'D

[illegible]

Wheat flour													
722	Whole (from hard wheats), 1 cup, stirred (120 gm)	400	16.0	2.4	93.2	4.1	146	4.0	(0)	1.6	14	5.2	(0)
723	90% extraction (from hard wheats), 1 cup sifted (110 gm)	405	13.2	1.1	91.5	2.6	210	1.4	(0)	2.9	0.8	2.7	(0)
726	Unenriched, 1 cup sifted (110 gm)	385	10.1	1.1	91.2	2.6	352	1.1	(0)	0.9	0.5	1.7	(0)
727	Enriched, 1 cup sifted (110 gm)	385	10.1	1.1	91.2	2.99	352	3.2	(0)	3.4	2.29	3.3	(0)
728	Patent												
	All purpose or family flour												
	Unenriched, 1 cup sifted (120 gm)	401	11.6	1.1	93.7	1.8	405	9	(0)	0.7	0.5	1.0	(0)
729	Enriched, 1 cup sifted (110 gm)	401	11.6	1.1	93.7	1.8	400	4.2	(0)	4.4	4.29	4.3	(0)
730	Bread flour												
	Unenriched, 1 cup sifted (112 gm)	409	13.2	1.2	93.7	1.9	106	1.0	(0)	0.9	0.6	1.1	(0)
731	Enriched, 1 cup sifted (112 gm)	409	13.2	1.2	93.7	1.8	106	4.2	(0)	4.4	4.29	4.3	(0)
732	Cake or pastry flour, 1 cup sifted (100 gm)	364	7.5	9	79.4	1.7	73	5	(0)	0.3	0.3	7	(0)
Wheat products													
	Bran, breakfast cereals See Bran												
733	Flakes, 1 cup (35 gm)	125	3.8	6	28.1	1.6	115	1.0	(0)	0.3	0.6	1.7	(0)
734	Flakes (added iron, thiamine, and niacin) 1 cup (35 gm)	125	3.9	6	28.1	1.6	115	1.5	(0)	2.0	0.6	2.2	(0)
735	Germ, 1 cup stirred (68 gm)	246	17.1	6.8	33.7	5.7	745	5.5	(0)	1.99	3.4	3.1	(0)
736	Puffed, 1 cup (12 gm)	43	1.3	2	9.6	6	39	4	(0)	0.1	0.2	6	(0)
737	Puffed (added iron, thiamine, and niacin) 1 cup (12 gm)	43	1.3	2	9.6	6	39	5	(0)	0.7	0.2	8	(0)

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value.

Use of proportionate quantity of liquid would double amount of thiamine and niacin and add one third more riboflavin.

\*Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity formulated under the Food, Drug and Cosmetic Act. Calcium is based on the level usually found in self-rising flour, which is in excess of the minimum (500 mg per pound) required. See introductory paragraphs.

\*Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity formulated under the Food, Drug and Cosmetic Act.

## COMPOSITION OF FOODS

TABLE 138--CONT'D

[illegible]

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